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SIMPLIFIED X-RAY METHODS.

By Harold C. Gage,
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A period of over two years work in X-ray laboratories at the front and in a base hospital in France has led to the evolution of new ideas and the modification of old methods in the effort to cope swiftly with a maximum number of cases at a minimum expense, while affording to the surgeons the utmost information and accuracy. The following description of ideas, which have proved useful towards this end, may be of interest to other military radiologists. To give an idea of the scope of the work on which these suggestions are based, it may be stated that 2,216 general observations have been made in this hospital within the last six months.

Of paramount importance is the question of fractures and foreign bodies. The latter and their localisation may be dealt with first.

Localisation of Foreign Bodies.—The following method is one which is not in itself new, but the appliances here suggested, and the improved technique,

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render it undoubtedly the best system for general localisation. It is independent, as will be seen, of any mathematical calculations ; it is absolutely accurate, and the results are self-proving, for the chart, when completed, discloses at once if the observations have been made correctly or not. The method is a screen one ; the appliances necessary are very simple, and can (like those in this hospital) be home made. (Illus. 1.)

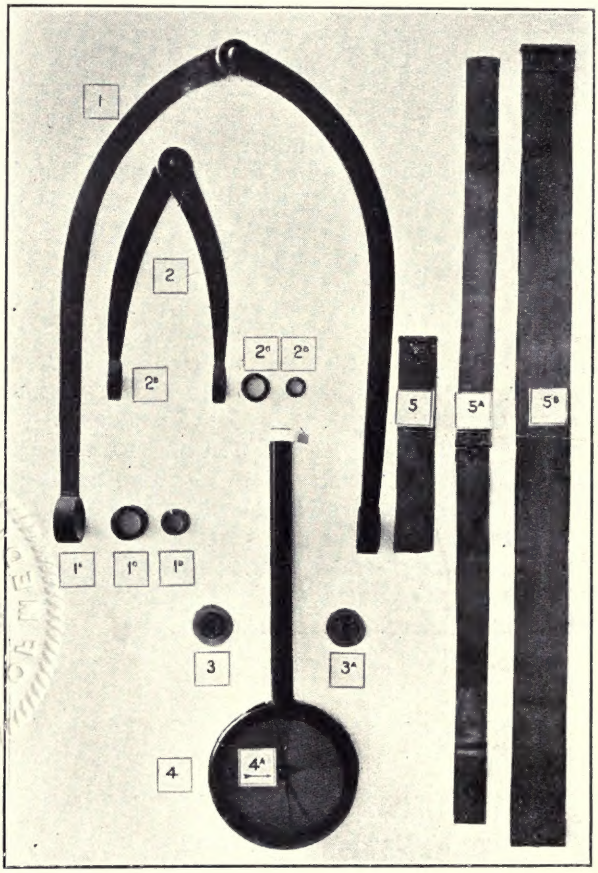

Illustration 1.—Localising Appliances.

Two or three pairs of compasses are shaped as illustrated in Figs. 1 and 2. Several sizes are necessary, as it is desirable that the rings shall be parallel when in use : a large pair (for the body) about 14 inches long ; a second pair about 10 inches ; a third pair about 5 inches. The rings in each case can be made to enclose smaller rings to facilitate the centreing of a tiny foreign body (Figs. 1 and 2, B, C and D). The body compasses can be further improved by adding a hinge by means of a small bolt and nut to the two arms at about 2½ inches to 3 inches from the rings. (Illus. 2, Fig. N.) With this additional adjustment the rings can be placed in contact with the body in any position.

In the first method the compasses are used in the following manner :—The patient is first placed, if a horizontal table be used, upon his back. Long sandbags may be laid on either side of the area of localisation in order to permit the insertion of the compasses beneath the limb or body. Other sandbags may be adjusted for the comfort of the patient. Should a table with sliding cross panels be in use, one of these panels may be removed to provide convenient access. Observations in the antero-posterior position are made, adjusting the compasses in such a manner that the foreign body appears on the screen encircled by the rings. (Illus. 3.) The skin is marked through these rings with a blue grease paint, and the patient then rotated. (In this rotation great care should be taken, for the accuracy of localisation depends upon the turning of the limb or the body as one would turn a cylinder, so as to avoid change of place in muscle or change of contour of the surface anatomy. If such a change takes place false relationships between the foreign body and the superficial markings on the skin are the result. With a little care, how-

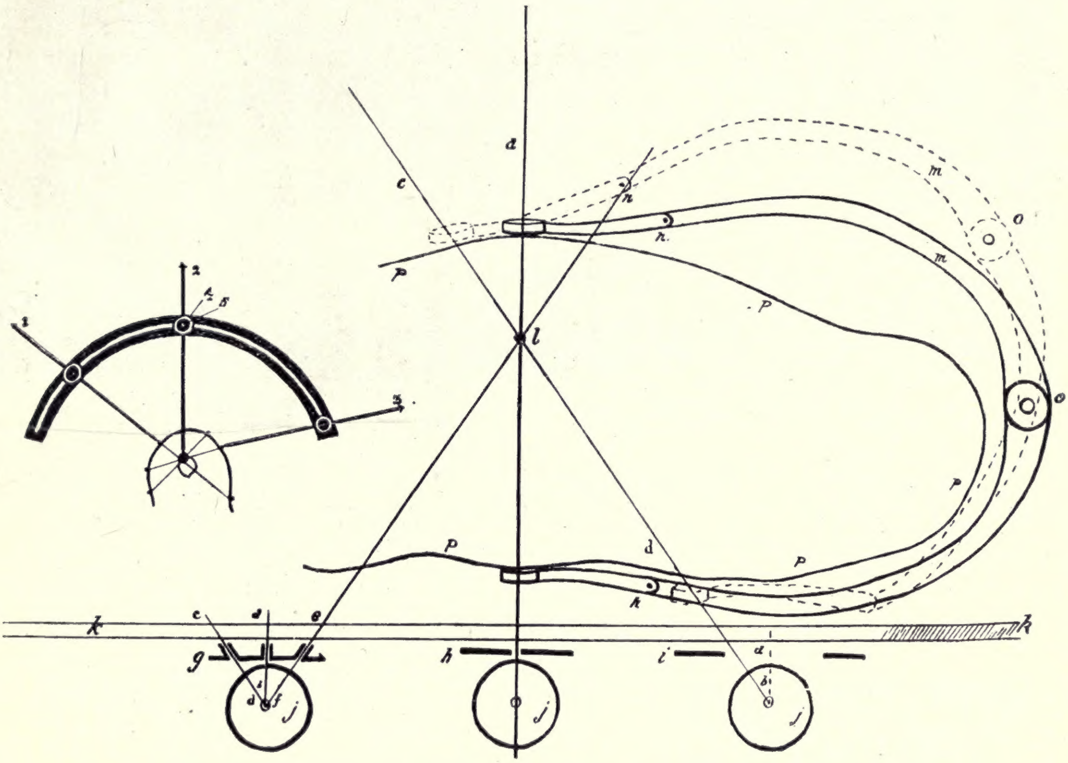

Illustration 2.—Diagrammatic application of compass, diaphragm and arc.

a.b.	Normal ray.
c.d. e.f.	Oblique rays.
g.	Diaphragm with tubes.
h.	Closed diaphragm.
i.	Open ,,
j.	X-ray Tube.
k.	Table.
l.	Foreign body.
m.	Compass.
n.	Additional hinges.
o.	Principal hinge.
p.	Patient.

Inset :—

Arc (for use at operation).

1 and 3.	Probes (in position on localisation marks on skin).
2.	Measured probe (in position on foreign body.
4.	Nut.
5.	Thumb-screw.

ever, and, in the case of the body, a vertical screening stand, this difficulty will not occur.) Having successfully turned the patient, the foreign body is again encircled with the rings of the compass (Illus. 4), and further skin markings made with a grease paint of another colour. This marking is then repeated in another position, making three observations in all, and giving six marks of three colours upon the skin.

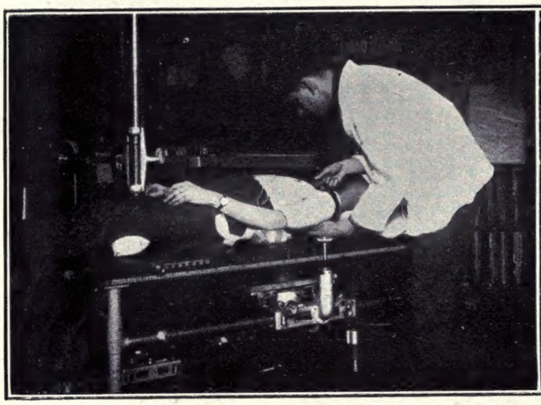
Illustration 3.—Localising. 1st position.

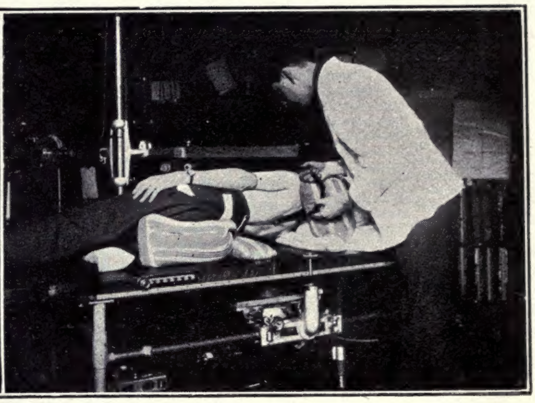
Illustration 4.—Localising. 2nd position.

Reference should now be made to Illus. 1, Figs. 5, 5a and 5b. These show strips of soft malleable metal, which can be obtained from any medical electrical warehouse; they are made of an alloy used for high frequency electrodes. The strips should be some 2 cm. wide for the limbs and 4 cm. wide for the body, and of various lengths sufficient to encircle the different circumferences of limbs and body. They are hinged in the centre. When in use (Illus. 5) the hinge should be placed upon some anatomical landmark to facilitate reference; the spinous process of a vertebra is very suitable for the purpose. "Right" or "Left" and "Anterior" or "Posterior" should be marked upon the metal. Care must now be taken to mould the band to the exact contour of the body. Where the metal overlaps a line is drawn, and the coloured markings on the skin are added to the metal band; also the wound of entrance or the incidence of the perpendicular drawn from it. The metal is then lifted, great care being taken to see that the contour is preserved, and placed upon a sheet of paper. With a pencil its internal contour is transferred to the paper, as also are the coloured marks. (Illus. 6.) The anatomical level of the foreign body should be

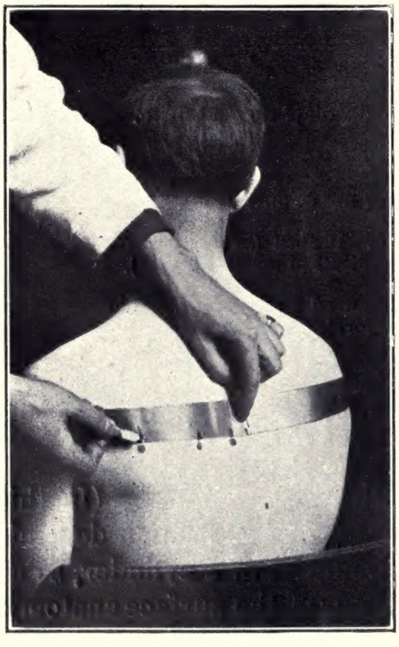
Illustration 5.—Taking the contour of the body and transferring skin markings to metal band.

noted, and, if the wound of entrance is not in the same plane, its distance superior or inferior measured. As an additional precaution, until the worker is familiar with the method, large wooden callipers may be used to take the lateral and antero-posterior measurements of the body, in order to confirm the shape and position of the transferred metal. The coloured marks are connected with the aid of a ruler, and if care has been exercised it will be found that the three lines intersect. Should this not be the case it is obvious that some error in technique has been committed. If the observations have been correct, the intersection will represent the position of the foreign body. The grease paint marks upon the skin may be rendered permanent by nitrate of silver.

Before passing on to the amplification of the chart, several methods may be suggested as preferable to some workers. If desired (and sometimes it is more convenient), small rings like those shown in Illus. 1, Figs. 3 and 3a, may be used in place of compasses. These rings, which may be of various sizes, are first placed on a disc of adhesive plaster, in the centre of which is a hole through which to mark the skin. Illus. 1, Fig. 4, shows a small fluorescent screen, perforated in the middle (Fig. 4a), to permit direct anterior marking without fixing a ring. This will be found very useful, as it saves time and facilitates the work.

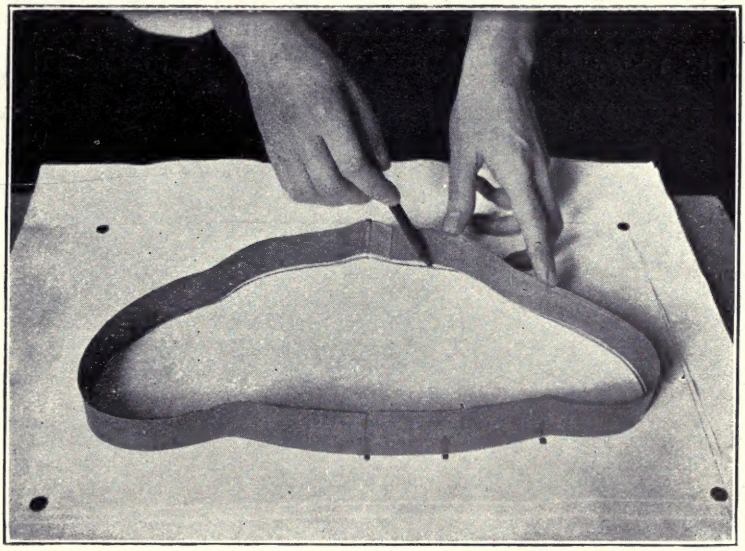

Illustration 6.—Transferring contour (and markings) to paper.

A second method is undoubtedly preferable, and can, when the necessary apparatus has once been made, be used generally, as it simplifies the whole procedure. An X-ray tube is so fixed that it can be brought very near to the posterior surface of the patient. (It might here be noted that it is advisable, in this case, to protect the patient by some small thickness of aluminium.) A long displacement of the tube must be possible in the direction across the patient. The tube having been well centred and the diaphragm closed down upon the foreign body, the antero-posterior position is marked through small metal rings attached to adhesive plaster as already described. The tube may now be displaced as far as possible and the diaphragm opened to include the foreign body, which is again encircled with the metallic rings and marked. This observation is then repeated in the opposite sense. To be able to work this method and to get a sufficient angulation, it will be found necessary to have the anticathode within 7 to 10 inches of the patient, but the time occupied in making these observations is so short that with an aluminium filter there is no particular risk if rays of a hard type are used. One further big advantage of this method is that the observations, providing the tube has been accurately centred, will always be in the same plane without the slightest deviation. The proceeding with the metal band is identical with that used in method 1. Some difficulty may be found in getting a sufficient displacement of the tube. Reference to Illus. 7 and 8 will show a means whereby it is possible to extemporise with a small bench placed at right angles to the X-ray table, or removable flaps may be adjusted to the latter. A simple diaphragm with three apertures may be used with advantage, as, for the lateral displacements, the wide open diaphragm gives a very diffuse image; or a better appliance can be made with the aid of three metal tubes, the centre one being fixed for the normal ray and the two lateral ones being adjusted by means of a rack and pinion to give the necessary beam at the angle required (Illus. 2, Fig. g). When a tube is used, instead of a simple opening in a sheet diaphragm, rings and compasses can be dispensed with, as the tube, after the antero-posterior observation, can be displaced until the foreign body appears in the circular beam of rays projected, and the skin marked with grease paint contained in a metal holder sufficiently opaque to show clearly on the screen.

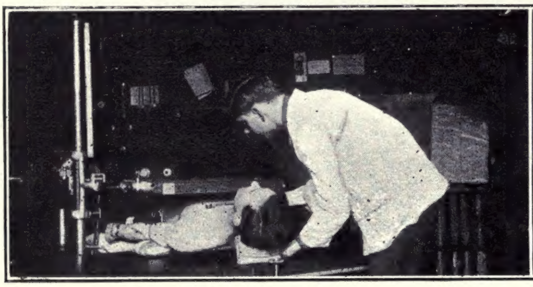

Illustration 7.—Tube displacement method with extemporised bench at right angles to X-ray table.—Observation with tube in central position.

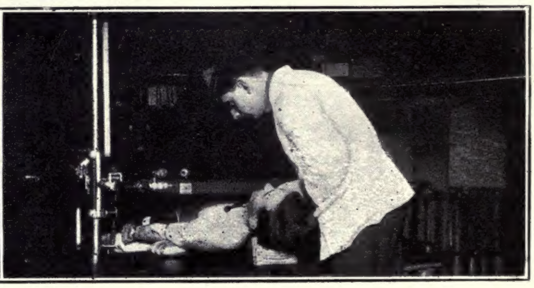

Illustration 8.—Tube displacement method.—Observation with tube displaced.

If it is desired to use the parallax method of localisation, in the case of a very sick patient, or by choice of the operator, the tube may be centred under the foreign body and the anterior and posterior marks placed upon the skin, after which a plate is placed over the anterior mark and an exposure made. The tube is then displaced to the greatest convenient distance and a second exposure made. In this manner a wall diagram can be used for the purpose of calculating the depth of the foreign body on this vertical line, as the displacement will be in the same plane. The contour of the body at the level of the markings should now be taken and transferred to a diagram with the antero-posterior markings; these are connected by a line, and the position of the foreign body recorded. Other marks may now be placed upon the outlined contour of the body in such a manner that lines drawn through them will intersect at the position of the foreign body; the marks are then transferred to the skin by replacing the malleable metal band. In this way choice of entrance with fixing points for the arc will be available at the operation, and the advantages of a "Cross Section Anatomy" utilised.

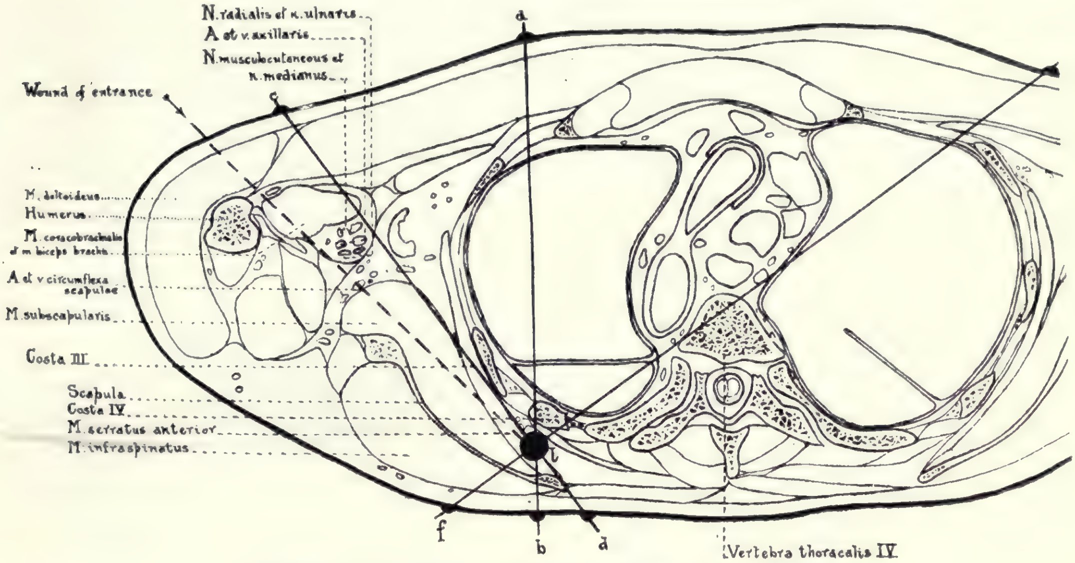

Illustration 9.—The anatomical amplification of the chart.

The Chart and its Amplifications.—Whichever method may have been chosen for the production of the skin markings, the proceeding for transferring them and the contour of the limb or body upon paper is the same, and the same intersecting lines are drawn. The cross section anatomical details of the area at the level of the foreign body may then be filled in. Reference to Illus. 9 will show in what manner these graphic amplifications may be made. Lines may be drawn showing the path of the projectile, and the chart will thus disclose not only the anatomical situation of the foreign body, but also the route it has taken to reach its position, as well as any vessels or organs which may have been injured in its transit. In the event of the wound being somewhat remote, other cross section diagrams at intervals will be of considerable help, or, if a sagittal section of the area is available, work may be saved by reference to it. With a chart so constructed the surgeon has

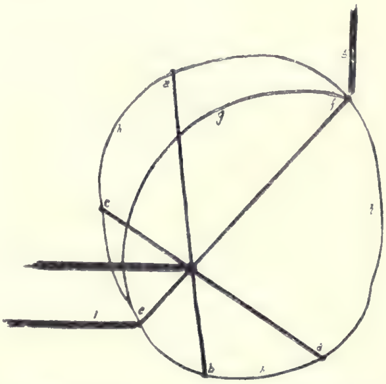

Illustration 10.—Localisation chart of head showing contour of the dome added to the localisation line.

definite information as to the exact position of the foreign body, with full confidence in the absolute accuracy of its localisation. He also knows the position of organs or vessels of surgical importance, near or distant, and by a glance at this chart the easiest approach for removal of the foreign body is at once obvious. If it has been observed in the radiograph that a bone, not in the direct course from wound to projectile, has been injured, the path of the projectile would be from wound to bone injury and from bone injury to the localisation. Transparent paper can, of course, be used in the preparation of these diagrams, so that, if desired, they can be superimposed on a "Cross Section Atlas" and the anatomical details traced in. Eycleshymer and Schoemaker's Atlas is very suitable.

Localisation of Foreign Bodies in the Head.—Additional precautions are necessary for the localisation of a foreign body in the head. An exact localisation can be made by using a length of wire to embrace the circumference of the head and passing it through the two marks of the first observation. It is then possible, during the subsequent observations, to turn the head in such a manner as to maintain the same plane, and to adjust the former so that the wire intersects the foreign body as a line and does not appear on each side as an ellipse. (This same technique may be applied with profit when making localisations with the open diaphragm, as in method 1.)

Further observations in localisation of foreign bodies in the head can be made by using a strip of soft metal, as previously described, for transferring the contour of the part. The metal should be placed so as to take the contour of the dome of the head vertically over any pair of localisation marks. The points chosen should be those best suited to the "Cross Section Anatomy" one may have at hand. It does not really matter which observation is taken so long as the two marks are on the same localisation line passing through the foreign body. This contour can then be added to the same localisation line on the chart (see Illus. 10), and a line drawn from the foreign body either to some part of the vault of the skull through which a surgeon would desire to trephine, or to the wound of entrance. If the line does not intersect the wound, or the most practical point of entrance, an observation can be made for the purpose. It will thus be seen that by choosing either of the three lines, or a fourth line made specially, the foreign body may be reached definitely through any desirable point or previous opening. The scalp can be marked by replacing the metal band, and at the subsequent operation the arc described below may be adjusted for the surgeon.

This arc (see inset of Illus. 2) is made of metal, and is constructed to take three movable fittings, each being bored for the passage of a probe. These fittings, which are in the form of composite nuts (Fig. 4), can be firmly fixed in any position on the arc while the probes (Figs. 1, 2, 3) are still left perfectly free for movement, the latter being fixed when desired by a separate thumb screw (Fig. 5) fitted in the nut. One of the probes (Fig. 2) is marked in millimetres. The arc is placed upon the diagram, the measured probe being placed on the point corresponding to that chosen by the surgeon for his

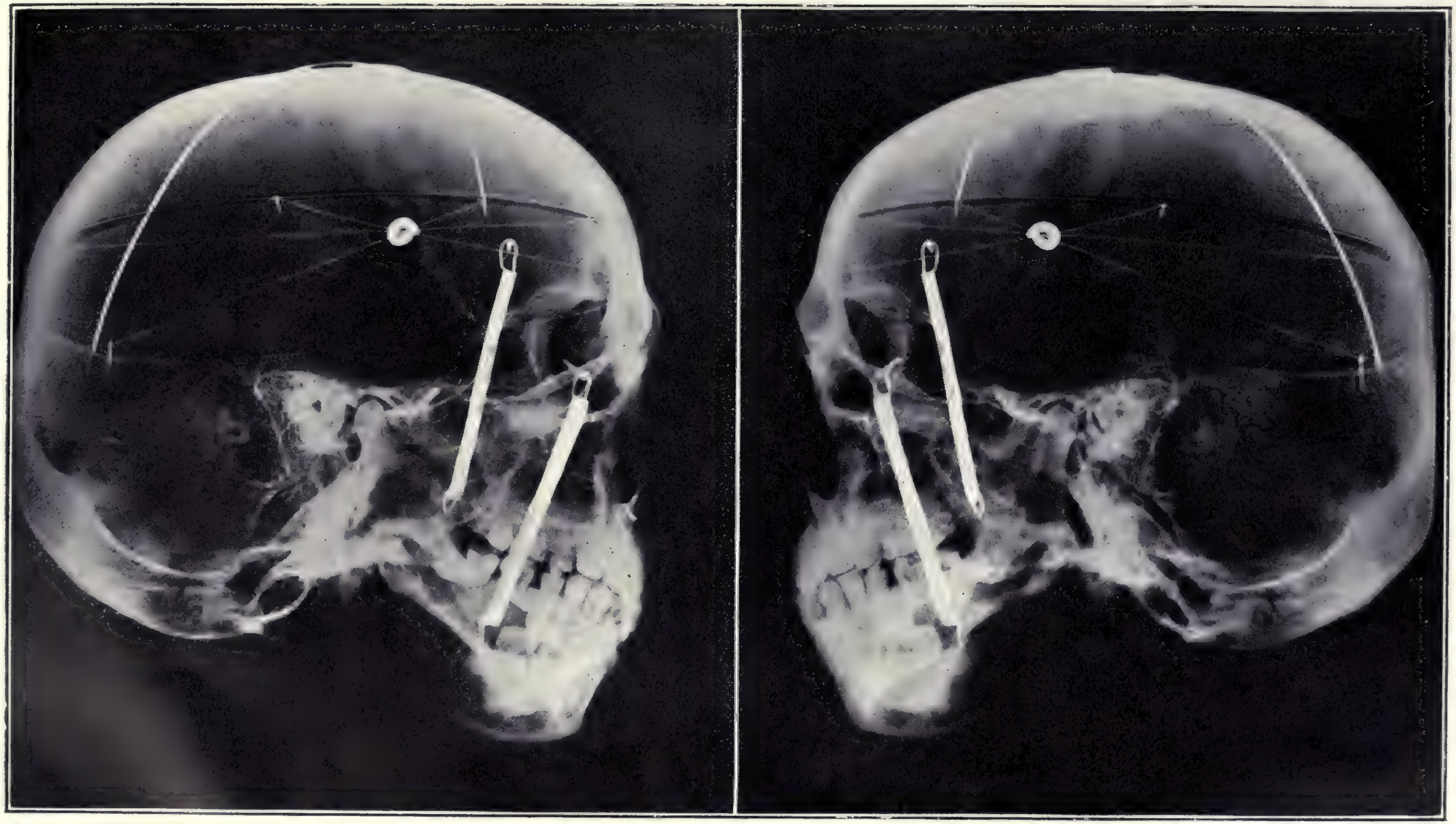

PLATE 1.

This stereo-radiograph should be viewed by the application of a mirror as suggested, when it will be found to help very considerably in elucidating the method of localising foreign bodies in the head.

incision, and the others on any other two localisation marks within reach. The nuts and screws of the two latter are now firmly fixed; the nut alone of the measured probe is made secure, and the probe is allowed to travel forwards to the position indicated as that of the foreign body. Notice is taken by the surgeon of the exact depth at which the point of this probe touches the foreign body through the area of the incision. The whole is then sterilised. This simple apparatus can be placed on the marks in the field of operation, and as the incision is made the central probe will mechanically follow, until, at the depth previously ascertained, it touches the foreign body.

Care should be taken in all circumstances to place the patient upon the operating table in the exact position he occupied when the markings were made. Although this is not so important as in most other methods of localisation, it is obvious that a localisation made in pronation would be invalidated should the operation be performed with the limb flexed or in supination. In other than gross changes like these the marks will be sufficient to give correct information.

It has been found possible in suitable anatomical situations to take a sharp-pointed probe or cutting needle, and by taking an observation of two points between which the foreign body lies, to push the needle home to strike the foreign body. This makes extraction possible through the smallest incision.

Statistics.—The number of localisations made in this hospital during the period from July to December, 1916 (inclusive) was:—

Localisations - - - - - - - - - - -		306
Foreign bodies removed - - - - -	295	
Foreign bodies localised but not operated for -	7	
Foreign bodies localised, operated for, but left in for surgical reasons - - - - -	2	
Foreign bodies missed by blunt dissection -	2	
	306	

The above figures include cases of foreign bodies successfully removed from lung tissue, brain substance, and the mediastinum.*

Simplified Stereoscopic Radiography of the Limbs.—The value of stereoscopic radiography is well understood, but the multiplicity of plates necessary is a considerable drawback, as also is the expensive and cumbersome apparatus for viewing same; but there is no part of X-ray work so important at this time as the examination of fractures for the position of the fragments and the presence of sequestra, their number, position and relationship to sinuses. This cannot be satisfactorily obtained by a flat plate, whether antero-posterior, lateral, or both. The following suggestion will do much to simplify the information one can give in these cases. In the first place, it is often desirable to obtain a radiographic image of the skin. This can be accomplished by carefully bandaging with gauze that has been smeared with zinc oxide or mercuric ointment, or, better still, impregnated with nitrate of silver or collargol. Bandages so prepared may be kept at hand to serve when needed, and should not be too wide, as it is essential that they should sit comfortably upon the contour of the limb. Where it may be impossible to apply a bandage it has been found effective to smear the skin with metallic ointment. A small metallic badge may be used to mark the sinus, and a letter (the same one as that used for the purpose of marking "Left" or "Right") should be placed upon the anterior surface of the limb. A plate is now taken, half of which is placed under the limb in the usual position with the film towards the tube, the other half of the plate being covered by sheet lead. The tube is centred over the limb and afterwards displaced 3 cm. laterally. After the first exposure the plate is carefully withdrawn without disturbing the limb, and the unexposed half of the plate inserted, this time with the glass side towards the tube. The second exposure is then made after the tube has been again displaced 3 cm. on the opposite side of the centre. It will be found that the best stereoscopic results will be obtained by increasing the displacement for a thin limb, like the forearm or hand, to as much as 4 cm. on either side of the centre; while for the thigh the displacement should be diminished. The height of the tube also has some influence upon the stereoscopic effect: the closer the tube is to the plate, the less displacement is required. To view these plates when so taken, all that is required are two mirrors, some 8 by 10 inches in size, placed back to back and bound, for convenience, with a piece of adhesive tape (Illus. 11). The whole of the plate must be equally illuminated. The mirror should be placed in the centre of the two pictures, and the observer should close an eye until he sees one picture clearly reflected; on opening the eye a stereoscopic projection of the contour of the limb, rendered visible by the application of the metal-impregnated bandage, will be seen, as also will the position of the sinus (marked by the metal disc) and the sequestra, which will stand out in their relationship to the sinus, the bone, and the skin. Sequestra, which would appear as one in a flat picture, will now stand out in relief, and can be counted and accounted for at operation.

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* **Removal of foreign bodies at operation has been facilitated in some cases by the vibrator and electric probe.**

Should the letter placed anteriorly appear on the side opposed to the observer, he is viewing the posterior aspect; to obtain the anterior aspect, he must incline the head to the opposite side and use the other mirror.*

Observations of Fractures and Foreign Bodies.—In making the first observations of fractures or foreign bodies, much expense and time can be saved by having a number of sheets of celluloid cut to a size which will drop into the frame of the fluorescent screen. Upon these celluloid sheets gross fractures and the position of foreign bodies may be traced with a grease (or glass) pencil. These celluloid tracings may afterwards be retraced on to paper. In this way a great economy of plates may be effected, and, in most cases, an equal amount of information obtained.

The Use of Bromide Paper.—Bromide paper, and the economy it offers, should not be forgotten, particularly in view of the comparatively large

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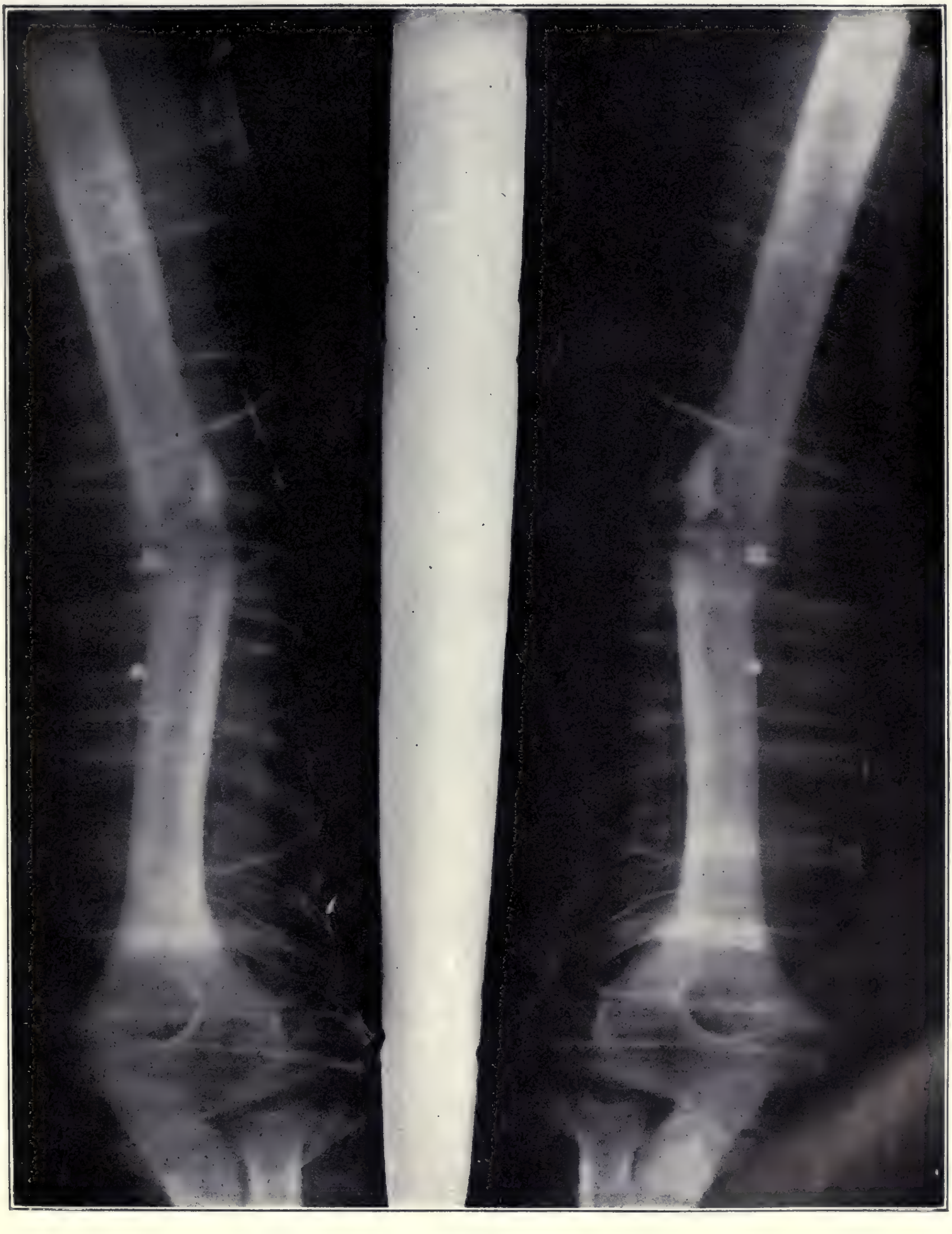
* For the purpose in hand it is not necessary to adhere rigidly to the principles of stereoscopy.



A typical stereo-radiograph which if viewed with mirror will immediately illustrate the advantages of the method described. (The sinus in this case is marked with a pin.)

PLATE 2.

quantity one can transport. It is quite possible to make very good radiographs with rapid bromide paper if an intensification screen be used for deep parts and for the limbs. It has been found that to get the best results when using intensifying screens, it is necessary to have the equivalent spark-gap of the tube some 25 or 30 per cent. less than one would use for direct radiography. This also applies to the use of plates. Bromide prints made in this way are particularly useful when only one copy is required to accompany an evacuation.

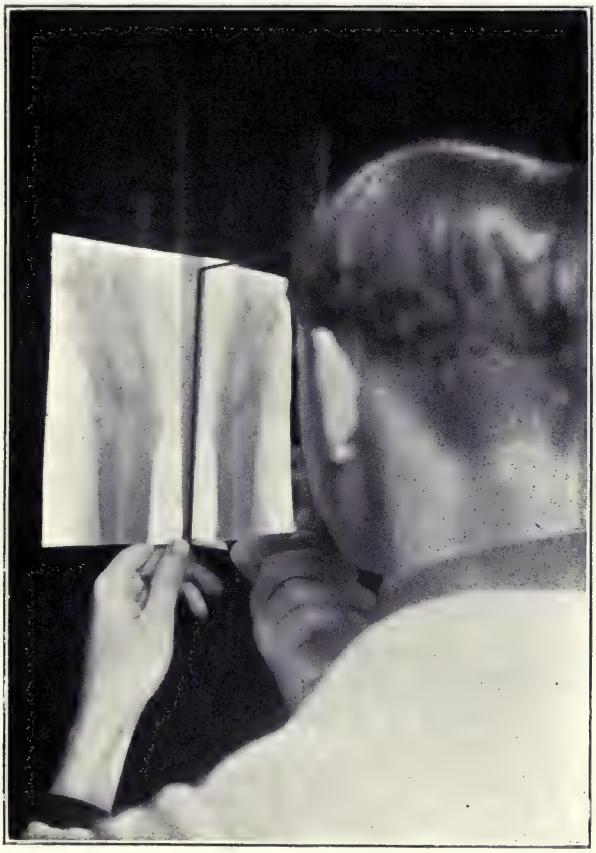


**Illustration 11.—Simplified Stereo-radiography.
Method of viewing plate with mirror.**

I have much pleasure in expressing my gratitude to Dr. Joseph A. Blake, Médicin-Chef of this hospital, who has not only offered encouragement and kindly criticism throughout the work, but who has given his valuable time and used his technical ability in making for me the mechanical appliances referred to in this paper.

ROENTGEN OBSERVATIONS ON THE DUODENUM WITH SPECIAL REFERENCE TO LESIONS BEYOND THE FIRST PORTION.

By JAMES T. CASE, M.D., F.A.C.S., Battle Creek, Mich.

Reprinted, with permission, from the *American Journal of Roentgenology*, June, 1916.

THE earliest roentgen studies of the alimentary tract following the ingestion of an opaque meal were carried out with special reference to the œsophagus and stomach. Five or six years passed before there were reported any systematic studies on the duodenum, yet in spite of its later development, the Roentgen findings in duodenal ulcer are more reliable and more accurate, even in the early stages, than in the investigation of gastric ulceration.

Of late, especially, has particular attention been given to the duodenum, with a resulting marked increase in the range of possibilities of diagnosis. Aside from ulcer of the duodenum, which has been fully considered by another speaker in this symposium, the following are conditions affecting the duodenum, or at least associated with the duodenum, in which the X ray may afford diagnostic aid: duodenal obstruction; gall tract disease involving the duodenum, as by adhesions; certain stages of pancreatic disease; diverticula of the duodenum other than the diverticulum of Vater; dilatations and tumours relating to the ampulla of Vater. The writer has made no special effort to be exhaustive in the foregoing enumeration, but only to stimulate a discussion of some of the newer possibilities of duodenal roentgenology.

Before taking up the consideration of these various topics, it may be well to briefly review the anatomy of the duodenum and to decide upon terms for use in describing the various segments of this very interesting organ.

Anatomically, the normal duodenum is divided into four portions—the first portion (pars superior, bulbous duodeni, the "cap"); the second portion (pars descendens); the third, horizontal portion (pars inferior); and the fourth, short portion (pars ascendens). The angle between the first and the second portions is called the genu superius; that between the second and third portions, the genu inferius.

In the adult the duodenum passes backward, upward and to the right between the quadrate lobe of the liver to the neck of the gall bladder; it then curves sharply, descending along the right margin of the head of the pancreas, generally to the level of the upper border of the body of the fourth lumbar vertebra; again curving sharply it passes transversely across the vertebral column, inclining slightly upward. In its fourth portion, it ascends for about two and one half centimetres, ending at the duodeno-jejunal junction, which with the patient supine is opposite the second lumbar vertebra.

The first portion of the duodenum, usually called the bulb, extends from the pylorus to the neck of the gall bladder. It is the most freely mobile of the four portions. To the upper border of the first half is attached the hepatico-duodenal ligament. The bulb is in such close relation to the gall bladder that it is often found bile-stained after death, the stain being especially noticeable on its anterior surface. This makes it easy to understand why the duodenum is so often involved in adhesions following pericholecystic inflammation. The bulb, which normally measures five centimetres in length, is usually triangular in shape, the base of the triangle forming the duodenal side of the pyloric sulcus. According to L. G. Cole, the duodenal bulb has the shape of a cap surmounting the pylorus, corresponding in size and shape with the pyloric end of the stomach. Its outline is smooth-edged, usually triangular or elliptical in shape. The mucous membrane is smooth unless there is actual disease present, there being in the shadow no trace of the serrations due to the Kerkringian folds which characterize the remainder of the duodenum.

The pylorus is seen roentgenologically as a circular constriction separating the duodenal bulb from the pyloric end of the stomach. The sulcus thus formed is usually about a quarter of an inch in diameter, and is bisected by a narrow shadow (the pyloric canal) which connects the stomach with the bulb. Even when the pylorus is closed, this narrow channel, measuring about an eighth of an inch in diameter, is visible, owing to the adhesion of minute quantities of barium to its mucosa. This adhesion of opaque salt to the mucous lining of the pylorus has led some into the error of contending that the pylorus is always open. When the pylorus is really open, the canal is seen ~~to~~ be widely distended, measuring as much as half an inch in diameter. The pyloric lumen thus visualized should occupy a midpoint in the sulcus in the gastro-duodenal shadow produced by the pyloric sphincter.

The duodenal bulb may occupy a position symmetrically above the stomach so that were one to cover the pyloric sulcus the shadow of the bulb would be seen to correspond in size and shape to the pyloric end of the stomach. Sometimes the bulb is not thus symmetrically placed ; it may be pushed to the left by pressure of the liver, or pulled to the right by adhesions, or it may be held in its normal position while the pyloric end of the stomach is displaced to the right or left.

The second portion of the duodenum is nine or ten centimetres in length, and with the patient in the horizontal position, extends along the vertebral column from the first to the third or fourth lumbar vertebra. Though this part of the duodenum is normally without a mesentery and is considered fixed, it is astonishing how readily it responds in most cases to the pressure of the manipulating finger. It is also subject to considerable change in shape and position during the movements of forced respiration. Occasionally one is able to make out the insertion of the ampulla of Vater into which empty the common bile duct and the pancreatic duct, about eight or nine centimetres from the pylorus. This portion of the duodenum invariably shows the serrations and feathery appearance due to the Kerkringian folds. Dwight found that the second portion of the duodenum may be very large, and yet not over-distended.

The duct of Wirsung and the common bile duct usually unite in a common channel to form a small oval or triangular cavity, known as the ampulla or diverticulum of Vater. This cavity lies in the wall of the duodenum, measuring, on an average, four millimetres in length. According to Opie, it may measure as long as eleven millimetres, while in other cases it may not exist at all, the two ducts opening side by side in the common papilla. The average diameter of the duodenal opening of the ampulla is, according to Opie, 2·5 millimetres. Sometimes this diameter may even exceed the length of the diverticulum.

The third and fourth portions of the duodenum together measure from seven to ten centimetres in length. Like the second portion, these segments of the duodenum are practically fixed, being bound down to neighbouring viscera and to the posterior abdominal wall by peritoneum, yet at times one is able to demonstrate an astonishing degree of mobility of the duodenal shadow. The fourth part and the duodeno-jejunal flexure are fixed by the suspensory muscle of the duodenum, called the ligament of Treitz.

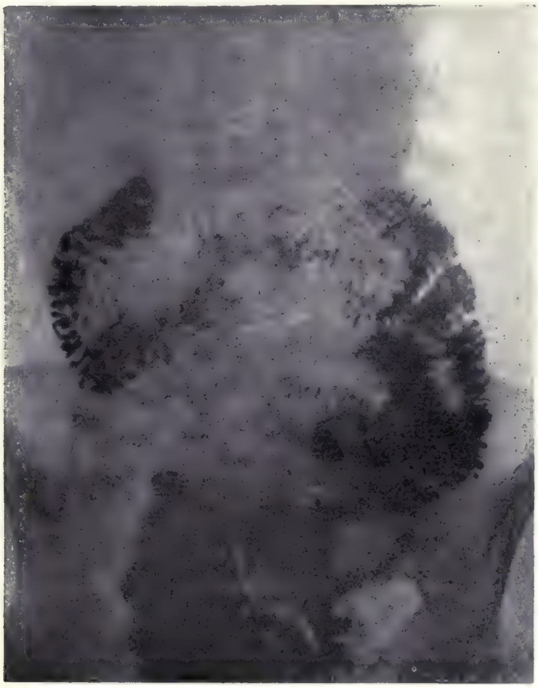


Fig. 1.—Visualized Small Intestine, showing Duodenum, Right Upper; Jejunum, Left Upper; and Ileum, Left Lower.

Note the feathery appearance of the duodenum and jejunum, due to Kerkring's Valves. The shadow of the ileum shows conglomerate denser barium masses.

Technique.—The patient, standing erect before the fluorescent screen, swallows a third of a glass of water into which has been stirred a heaping teaspoonful of barium sulphate. One watches particularly the pyloric region for the behaviour of the first of the opaque mixture to reach it. This barium-water mixture usually begins to pass at once into the duodenum, so that one is able to show that the duodenum is more or less well visualized from the very beginning of the meal. This is followed by the usual barium meal, which, in the writer's practice, consists of one ounce of barium sulphate in a glass of hot malted nuts or hot malted milk, and one ounce in a glass of buttermilk, given cold. A brief further observation is made with the patient erect. He is then placed upon the horizontal table, and if any delays are incurred, he is asked to spend the interim lying on the right side. When all is made ready so that the observation can begin the instant the patient turns on the back, he is asked to inhale, hold the breath and turn quickly upon the back. The observer with one hand makes pressure over the duodeno-jejunal junction, at the same time pressing pylorusward the contents of the stomach. Special care is taken to compress the duodenum between the palpating hand

and the spine, thus artificially obstructing the duodenum, and incarcerating its contents. The use of a wooden spoon device is an addition to the safety of this manœuvre. This method of blocking off the duodenum, which the writer has practised for the last five or six years, can be accomplished more satisfactorily in the horizontal than in the upright position, although the technique for the upright position worked out by Holzknecht and Lippmann has a certain value. By pressure over the duodeno-jejunal junction, which is thus shut off between the spine and the compressing finger, the duodenum is easily filled from pylorus to duodeno-jejunal junction and its entire contour easily made out. The alternating waves of onward and retrograde peristalsis resulting from this temporary obstruction still further test the elasticity of the duodenal walls, so that one is no longer in doubt as to the presence or absence of deformities.

At irregular intervals, depending upon the mechanism which controls the opening of the pylorus, the duodenal bulb contracts, the contraction appearing about two centimetres beyond the pylorus. This contraction is occasionally seen to begin at the pylorus itself. This contraction in the bulb occurs when an antrum contraction is nearing the pylorus, usually when the antrum contraction wave is about an inch from the pylorus. Serial roentgenograms, according to the method of Kaestle, further developed by Pirie, will demonstrate beautifully the nature of this duodenal bulb contraction. This is a ring contraction wave which carries a bolus of material usually the entire length of the duodenum past the duodeno-jejunal junction. Were one to depend solely upon roentgenography for his Roentgen findings, the appearance of barium traversing the duodenum in connection with one of these ring contraction waves might lead to an erroneous diagnosis of duodenal obstruction. One frequently sees reverse peristalsis in the duodenum. This is independent of respiration, as can be seen by studies during suspended respiration. Although in obstruction of the duodenum one may observe reverse duodenal peristalsis, these waves are not necessarily pathognomonic of an organic obstruction. They may also be seen when an emaciated patient is lying upon the back and the duodenum is compressed by saddling across the spine.

A study of the duodenum with the patient in the right lateral position is also useful. The patient lies on the right side, with the screen held directly in front of him. The rays penetrate from behind. This position is especially useful in studying the pyloric region, but also lends itself to a study of the duodenum.

(To be continued.)

REPORTS OF SOCIETIES.

FLUORESCENCE AND PHOSPHORESCENCE, AND THEIR USE TO PRODUCE LUMINOUS EFFECTS.

(Introductions to a Discussion held at the Royal Society of Arts, Thursday, March 22nd, 1917.)

I.—The Production of Fluorescent and Phosphorescent Effects.

By F. Harrison Glew, F.C.S.

In general, illuminants operate by incandescence, *i.e.*, the production of light through high temperature. Other processes, not involving the action of heat, are termed luminescence, and are illustrated in a few illuminants, *e.g.*, the mercury vapour lamp and, to some extent, in flame arcs.

To illuminating engineers the processes involved in luminescence have therefore a direct interest, apart from the wider aspects of these phenomena.

One of the most familiar examples of such effects is the firefly, the luminous efficiency of which is believed to be far higher than any existing illuminant, and other insects and marine forms of life have similar properties. The production of light appears to be due to chemical action. The glow of phosphorus (from which the term "phosphorescent" is derived) in the dark is due to slow oxidation, and luminosity may also be produced by the oxidation of pyrogallic acid and other organic materials. Such effects are termed "chemiluminescence."

"Tribo-luminescence" is the term applied to luminous effects produced by friction, *e.g.*, by rubbing or scratching certain crystals (quartz, sugar, fluorspar, etc.).

When the impact of visible light on a substance produces luminosity of a different (by "Stoke's Law" a lower order) colour, this is termed "fluorescence." The effect is exhibited by fluorspar and similar crystals. When the effect still persists after the cessation of the stimulating action so that the luminosity persists in the dark, it is termed "phosphorescence." A good example of fluorescence is to be found in the transformation of violet and ultra-violet light into visible red rays by the rhodamine reflector, used with the mercury lamp to modify its spectrum. Fluorescence may be excited by other forms of radiation, for example, that emitted by an X-ray tube, or the spark from an induction coil.

Luminous paints which, after exposure to daylight, retain luminosity for some time in the dark, have been known for many years. Crystals of calcium sulphide phosphoresce blue, zinc sulphide green; other materials give a less luminous effect in yellow, red, and other colours. The manufacture of such substances and ingredients used to accentuate their action is a complex process, as qualities quite apart from chemical purity are required. For example, the form of zinc sulphide, giving the best luminous effect on exposure to daylight, may not be that most suitable for treatment to produce continuous fluorescence.

The luminous effect induced by light in these substances is transient, diminishing greatly after a few hours in darkness. At the moment, immediately after strong excitation a brightness possibly exceeding one foot-candle may be shown to exist. But in a fraction of a second this initial strong effect vanishes, and although thereafter the diminution is more gradual, a brightness below that of a white surface illuminated by moonlight is soon reached, and half an hour afterwards the luminosity is very much less still. Experimental data on the degree of luminosity attainable by strong excitation by sources rich in ultra-violet rays are needed, but the measurements involved, as Mr. Blok will show, involve great difficulties.

Such phosphorescent substances have found various special applications. The strongest effect is produced with the substance in a powder, but, mixed with dilute varnish, it can be applied in the form of paint.

The most important practical results have so far been obtained with the self-luminous paints, which consist of zinc sulphide with a small admixture of radio-active constituents. Radium gives off three forms of rays—alpha, beta, and gamma—the former of which is responsible for the chief excitation of luminosity. Radium itself wastes away at a rate which will reduce it to half quantity in 1,000 years, This alone, therefore, would cause an inappreciable deterioration in luminous effect. In fact, however, self-luminous paints decay at a rate varying according to their radium constituent. A diminution of 50 per cent. in brightness in the course of a year is not unusual, but much greater diminutions with a larger percentage of radium have been recorded. Half value in about 24 hours occurs with 74 mgrm. radium bromide per gramme of zinc sulphide, which strength I find to be equivalent to the light of the glowworm. On the other hand, the actual brightness, within limits, is roughly proportional to the radium content. It is therefore of very great importance to determine the order of brightness necessary for certain purposes, and not to exceed this required value, since any addition beyond this point adds to the expense and diminishes the life of the material. Up to the present time no satisfactory means of regenerating these materials have been found, although this is possible with some substances. The diminution in brightness, as stated above, cannot be attributed to decay of the radium component, and is believed to be due mainly to deterioration of the zinc sulphide during bombardment. In cases in which the powder is enclosed in glass, the transparency of this may also be affected by the radium in course of time, and the same applies to the varnish used as a binding material when the compound is applied in the form of luminous paint.

It is to be noted that the mixture with varnish is equivalent to dilution of the radium element; speaking generally, the brightness of material of given composition used as varnish will be about one-quarter of the value when used in the form of powder.

Such materials have many important applications in connection with the war, and the whole subject offers an opportunity for profitable research, and deserves to be more closely studied.

II.—Some Applications of Fluorescence and Phosphorescence.

By J. S. Dow.

The subject for discussion is one on which little is generally known. These phenomena, and their relation to the complex problems underlying the production of light, are of great interest to the Society. The use of luminescence in such illuminants as the flame arc, the mercury vapour lamp, and possibly the incandescent mantle, are of interest, as suggesting the possibility of more efficient light-production than can be obtained by incandescence effects; and also because they involve free vibrations of certain wave lengths, offering the hope that eventually we may be able to control the colour of light for various purposes, as easily as we now control the intensity. The firefly has long been regarded as one of the most efficient sources of light, and researches on phosphorescent substances suggest that such forms of "cold light," though relatively feeble in intensity, have almost invariably a very high luminous efficiency. Yet the experiments on this point are a little doubtful in view of the very low luminosity, and the possibly misleading effect of the physiological complexities of the eye in such circumstances. From a scientific standpoint it would be very desirable to determine the luminous efficiency of such processes with greater precision.

The effect of such substances in the dark is also of interest in view of its bearing on the matter discussed at the last meeting—the influence of glare and contrast. The visibility of these substances depends very much on the state of adaptation of the eye. A small patch of luminous paint, particularly the blue light from phosphorescent calcium sulphide, can only be seen with difficulty by an eye recently adapted to ordinary artificial light. On the other hand, in the writer's experience, the brighter forms of self-luminous paint may, to a fully dark-adapted eye, produce an effect not unlike actual glare. It is therefore very important, as Mr. Glew has suggested, to determine the minimum brightness requisite for various purposes, and not to exceed this minimum. Another effect, also clearly in evidence with the blue light of calcium sulphide, is the "spreading" of the light at distances exceeding a few feet, owing presumably to the chromatic aberration of the eye. Again, a patch subtending a small angle of the eye appears much less bright than a relatively large area, which also tends to make the surface painted fade out of sight, and, indeed, become invisible to direct vision, at a short distance away. These effects limit the applications of such substances in their more feebly luminescent forms. Except when one can deal with relatively large areas, they are best suited to near vision. For the same reasons the photometry of a small area may not give the true effect of their use over a large surface.

As regards the order of brightness met with, it would appear from tests by various observers on various self-luminous paints (zinc sulphide) that the following rough rule might be tentatively suggested, viz., that the actual brightness in equivalent foot-candles is rather less than one-tenth of the radium content in one gramme of composition. Thus 0·4 composition (*i.e.*, material containing 0·4 milligrams to one gramme of radium bromide and zinc sulphide), yields *about* 0·04 ft.-candles, and 0·2 composition *about* 0·02 ft.-candles (*i.e.* about the brightness of a white surface illuminated by full moonlight). For reasons already given, it is impossible to state such a rule with precision, but as a rough guide this may be useful. To much more powerful compositions it may not apply.

The brightness of zinc sulphide or calcium sulphide a few minutes after exposure at close range to a 50 watt electric incandescent lamp (which is typical of the type of source available to the ordinary householder) is already very much less than the " moonlight " value. From tests on some samples of the calcium sulphide "luminous buttons" now being sold for use in the dark streets, the writer has found that, after the above exposure, they were practically indistinguishable to direct vision at a distance of ten feet, within an hour after exposure. These buttons were about 1½ inch in diameter. The brightness in such circumstances would, therefore, not be of much help in enabling people to avoid being run over by vehicles; but they might be useful in preventing collisions of pedestrians in very dark areas. On the other hand, if such material was available in large quantities for coating kerbs, lamp posts, etc., the larger area treated would alter the problem, and they might possibly have applications in places where there is practically no artificial light provided, or in enabling a party to keep in touch with one another when traversing a wood at night. The successful use of such devices seems at present to demand conditions of such low luminosity as practically excludes the use of artificial light. Otherwise a piece of white card may appear equally bright. On the other hand, little is known regarding the persistence of luminosity excited by sources very rich in ultra-violet light, such as the quartz tube mercury vapour lamp. After such exposure effects sufficiently permanent to be used for theatrical effects are said to have been produced. Luminous paint is also said to have been used for coating buoys and other marine objects, the luminosity induced by the sun's rays being reproduced during the dark hours of the night. In the absence of any artificial light this project seems more feasible, especially in the strong sunlight of the tropics. If phosphorescing substances could be produced commercially on a large scale and at a cheap rate, new applications would doubtless present themselves. In small quantities their successful use seems to demand frequent excitation by sources rich in ultra-violet rays. The writer has tried coating switches with calcium sulphide, but the relatively low general illumination in an ordinary interior is not alone enough to produce a useful effect.

On the other hand, the self-luminous materials, continuously excited by radium, have already many important special applications. The chief present limitations to their wider use are scarcity of supply and expense. It has, however, been recently calculated by a writer in the *Electrical World* that the weaker and less expensive forms of such materials could be used for coating switches at a cost of only 1d.—1½d. per switch.

III—The Photometry of Luminescent Substances.

By Arthur Blok.

The measurement of the brightness of fluorescent and phosphorescent substances is rendered difficult by two factors—(i) the colour of the light, the spectrum of which usually consists of bands or lines situated mainly in the green or blue; and (ii.) the relatively low luminosity. Both of these factors tend to introduce the Purkinje effect. Fortunately, the chief data required are usually relative, and one can thus work throughout with a coloured screen placed in front of a comparison lamp, and designed to give a colour which more or less matches the light of the material tested. If one wishes to obtain absolute values of brightness, allowance must be made for the absorption of the screen; but the procedure for effecting this introduces all the physiological difficulties attendant on heterochromatic photometry at low illuminations. An approximate colour match may be obtained fairly easily, for example, by the use of signal green glass in testing phosphorescent zinc sulphide, but unless the spectral composition of the two lights compared is substantially identical, errors may be introduced by the order of luminosity at which the test is made, the part of the retina upon which the image is received, and perhaps, also, by the size of the photometric surface employed.

Various photometric methods have been devised for dealing with this class of substances, and in these a colour-matching screen is almost always employed. In the method described by N. E. Dorsey, a lamp is moved back and forth behind a translucent screen forming one end of a box, and the luminous compound under test is mounted on the outer surface of the screen either in the form of paint on a card slip or in powder form in a thin-walled glass tube. Identity of colour is produced by a colour filter placed inside the box between the lamp and the screen. With this arrangement, the tested sample appears as a luminous island in a surrounding sea formed by the variably illuminated screen, and provided that a sharp line of demarcation can be obtained between the island and sea, there is much to recommend this plan—immediate contiguity of the two luminous areas under comparison greatly facilitates the determination of photometric balance.

In the method used at the National Physical Laboratory for comparing the luminosity of painted dials, a stencil replica of the dial under test is uniformly illuminated from behind by means of a glow lamp and a colour screen. The stencilled and actual dials are mounted side by side, and by means of a variable resistance the candle power of the lamp is brought to such a value that the luminosities of the stencilled figures and those on the actual dial are the same. By an independent calibration with a surface-brightness photometer, the brightness of the stencil for any resistance setting is known. Here, the mean effect over the whole of the surfaces viewed is judged, and as long as the dials are small there should be little difficulty in doing this. But if the dials are large, the various figures will be at different distances from the eye, and it would appear that trouble may be introduced on that account. The method, however, has the advantage that by enabling finished dials to be dealt with in their entirety it gives a final comparison of their merits, whereas if small samples of paint are measured there is always the possibility that variations in the finished article may be introduced during the painting operation, for example, by irregular mixing or uneven application of the paint.

In another scheme, developed by Prof. Clinton and Mr. Dow for measuring some very small samples in association with the speaker, the sample is viewed at a constant distance from the eye through a small opening in a white screen placed at an angle of 45 degrees to the line of sight and to the axis of the photometer bench (the line of sight being normal to the bench axis). The opening is of such a size as to be completely filled by the luminous specimen fixed behind it—*i.e.*, the "island and sea" plan is adopted. The inverse square of the distance of the lamp from the screen at photometric balance is proportional to the luminosity of the sample.

A point to be borne in mind in speaking of the photometric values of self-luminescent substances is that the luminosity of the material in powder form is considerably higher than when the material is mixed with varnish or other substance to form a paint. Moreover, the thickness of the layer tested to some extent determines the foot-candle value. A further factor which may influence the result is the treatment of the substance in regard to exposure to light before the test. In the case of substances like Balmain's compound, this is obviously a matter of prime importance, but with materials depending on radio-active excitants for their luminosity, the effect of previous light action is, as far as the speaker is aware, not yet thoroughly known. Indeed, it is very evident that for the systematic specification of these self-luminous substances standard test conditions still remain to be worked out.

For some purposes, a single photometric measurement on any of these materials may suffice, but usually it is equally important to know the rate of luminous decay with the lapse of time. It is somewhat remarkable that although the chemical and physical sides of radio-activity and phosphorescence have been brought to a very advanced stage, very little appears to have been published on the luminous values of the substances now under discussion, and one looks almost in vain for data on the practical matter of variation of foot-candle values with time for a compound of a given nature. The present activity in night operations in the war has caused a very great demand for self-luminous compounds, and, no doubt, the results of tests extending over moderately long periods will be available presently. Such tests require very great care, for at best the initial luminosities under measurement are small, and after some time they sink to values that are very difficult indeed to measure, at any rate by the eye, which after all is the instrument with which the substances are used in practice. The products now used commercially have brightnesses of the order of a few hundredths of a foot-candle, and give nearly monochromatic lights. These are conditions that tax the photometrist, and the repetition of observations to 5 or 6 per cent. in tests of this nature would indicate very good work.

On the whole, there seems to be a large field for the application of photometric methods in the investigation of these substances. The subject of self-luminescent materials is at the interesting stage where practical applications are emerging, and those who are conversant with the better known applications of photometry in lighting work generally might well devote attention to the investigation of the luminous phenomena exhibited by the class of bodies now being discussed.

RÖNTGEN SOCIETY.

Captain C. Thurstan Holland, M.R.C.S.,
Nov., 1916.

Presidential Address.

(*Continued from* p. 403, Vol. XXI.)

So far I have said nothing as to "Electro-therapeutics," but all that I have said applies with equal force to this branch of medicine. The great advances made during the past decade in various forms of apparatus, and the equally great advances made in methods of treatment scarcely require that attention should be called to them—they are matters of common knowledge.

Electrical methods of treatment have in the past suffered much from the halo of quackery which has surrounded them. The men into whose hands these methods of treatment fell were many of them, at any rate to a certain extent, charlatans. Now this is largely changed, and the electrotherapeutic work which the late Lewis-Jones did so much for, is at many of our larger hospitals being carried on most efficiently, and in the best traditions of medical research, by a number of highly skilled, highly efficient men. Of the value of electrotherapeutic methods what greater proof is required than the knowledge of what these methods have done for the wounded in this present war; methods which have been brought forward in a remarkable manner by the requirements of the wounded; and the necessity for trained, qualified medical men to superintend this treatment has become very obvious indeed.

In 1915, at the Radcliffe Infirmary, Oxford, under the direction of my friend, Major Turrell, 17,225 treatments were given by various electrotherapeutic methods, mainly to soldiers. The enormous yearly increase of this work at this one hospital shows in a striking manner of what value the results are when such a department is directed and controlled by a thoroughly efficient medical man who understands his apparatus, its applicability to individual cases, and whose thorough knowledge of medicine and surgery enables him to apply to each case the individual treatment indicated in a scientific, as opposed to a merely haphazard, manner. I instance Major Turrell in this way because I have seen, and been much impressed by, his methods, and the manner in which his hospital department is carried on, but I have no doubt whatever that there are many others in the country where medical men are doing equally good work on similar lines. The real point is that this work is becoming of more and more importance in all directions, the different means at our disposal for effecting certain results are becoming more and more varied, the profession generally is recognising the value of such work and the necessity for skilled medical control, and it follows that those who are to exercise this control must have the means of acquiring the knowledge to fit themselves for the work. That is to say, that the teaching must be recognised and regulated.

One cannot draw hard and fast lines between X rays—radium, and various electrotherapeutic methods, they merge into one another. Only in one respect X rays stand alone, and that is in their diagnostic capabilities. Putting this aside, from the treatment point of view X rays, radium and the rest ought all to be under the same roof, at any rate. Especially does this apply at the present time to radium. At the Royal Infirmary at Liverpool the radium treatment is controlled from the X-ray department; at Manchester the departments adjoin. The time for separate radium institutions, where this is the one and only method of treatment adopted, has gone by, it is a system which must of necessity lead to abuse. Now I fear that all this is somewhat rambling and disjointed, but the main idea underlying it all is, I trust, clear.

It is the necessity:—

1. For the proper recognition of radiology and electrotherapeutics, and the teachers of these subjects, at hospitals and universities.
2. For the proper teaching of these subjects by men especially equipped for doing this, and their recognition as University teachers.

In many countries this teaching is being organized and carried out on proper lines; in many countries University Professorships and Lectureships have been given to medical men qualified for such posts. We must not lag behind. Perhaps some of you may think that in the middle of this great war matters of this kind are not of great importance. I do not agree. We have got to prepare for the peace we all look forward to, and no harm can come by the ventilation of certain things asking for reformation and accentuated by conditions brought about by the war itself. America has been moving strongly from the X-ray point of view. In quite a number of Universities and hospitals and colleges are Professors of Radiology and of Electrotherapeutics; and in others lecturers on this subject, and it follows upon this, of course, that there are special courses and special lectures for teaching purposes.

America is by no means the only country in which similar conditions exist.

Teaching requirements may be considered for a few moments:—

1. There are the assistants. That is to say, the non-medical assistants, nurses for the most part, but also some males; those who must of necessity carry out much of the actual work in the X-ray department of hospitals, and also act as assistants to medical specialists in their private work. The place of these people, as I have pointed out before, is merely that of assistants. They work directly under medical control, accept no responsibilities of any kind, and merely do as they are told. Such assistants require training in the photographic part of X-ray work, in the direction of the management of apparatus, and so on; should be able to administer definitely prescribed doses of X rays, or mechanically administer various forms of electrical treatment, should also be taught to take plates of cases according to a routine laid down by the chief. But they should not be allowed, nor should they be expected, to make diagnoses from plates, to give opinions, to make screen examinations of such parts as chests or stomachs, to regulate the treatment of cases, or in fact do any definite medical work on their own responsibility. The teaching of such assistants is already carried out in most departments of large hospitals from the point of view of the requirements of the individual departments, but it should go further than this. Definite instruction should be given in order that there should be a number of such assistants qualified to take up similar posts at smaller hospitals and other institutions, and it should be possible to certify such people as being proficient in such a way.

2. There is the necessity for post-graduate teaching, and this must be arranged from two points of view. At the present time elementary post-graduate courses are of the greatest importance, as so many of the practitioners had left hospital before either X-ray work began, or before it reached its present position. There will, however, always be a necessity for this teaching in order that medical men in general practice may have an opportunity of keeping themselves abreast of the times. For many years I found in my work that nearly every case came to me on the recommendation of a consultant; it still is the fact that the large majority of cases come in this way; of late years, however, there has been a growing tendency on the part of the general practitioner to have many of his cases examined from the X-ray point of view before calling in a physician or surgeon. This condition of affairs will, I believe, go on, and more and more work will come in that way as the medical student and so the general practitioner gets more and more knowledge of the possibilites of radiography.

The second-class of post-graduate teaching is of even more importance; that is the provision of means by which the man who intends to specialize may fully study the subject. Up to now practically no systematic teaching of this kind has been available. Here and there a man has been allowed the run of a department, and has been allowed to pick up the work as best he could, generally because he has laid himself out to be of some use in the department, but he learns on no system and it largely depends upon himself as to how much he does learn. This entirely haphazard method of instruction should give place to a definitely arranged course of lectures, demonstrations and practical work. Of course, neither X rays nor electrotherapeutics can be taught entirely by lectures; practical everyday work in a large hospital department must be the basis of the teaching, but lectures and demonstrations should be part of the course, and speaking in a very general way it seems to me that such a course of study ought to extend over a period of at least six months.

3. And now I come to my final problem. This is the medical student. This unfortunate individual is already so overburdened with subjects, lectures and classes, all arranged for examination purposes, that it is said to be impossible to add any more to the curriculum. The answer to this must be that X-ray work has become of such overwhelming and paramount importance that it cannot, and must not, be shelved any longer. The public, and not the medical student, is what has to be considered, and the medical student does not imbibe knowledge on his own account, but because it may enable him to practise as a medical man in a safe and reliable manner; therefore I say it is essential that the student should be compelled to imbibe some knowledge of what is now the most important exact means of diagnosis there is in a large and growing field of diseases, and that as the large majority of students will eventually become general practitioners they must have this knowledge before being let loose upon the public.

The future general practitioner must have at any rate, enough knowledge of X rays and electrotherapeutics to enable him to know when an X-ray examination for diagnostic purposes is indicated, when he should recommend to a patient treatment by one or other of the various electrotherapeutic methods. Now it is a well known fact that the medical student will not imbibe knowledge for its own sake, but only from the examination point of view—of course, this applies to the average student—and unless he has the fear of the examination before him he does not attend lectures and classes. I believe that the time has come when it is essential that a course of Radiology and Electrotherapeutics must be included in the curriculum, and that in the final examination questions upon these subjects should be a possibility. Then the corollary to this becomes obvious: the teachers of these subjects must have recognised standing and position.

I do not intend to labour this point further, and I do not intend to place before you any scheme, but it is, I believe, essential that a start should be made at some university. This start will, of course, take money. Someone who has been making an immoderate fortune by shipping or by food supply may, if he happens to read this address (I understand it will be eventually published), feel impelled to find salvation by putting some of his gains to this useful purpose, a rather more useful one than that which occurred at the University of Liverpool only a week or two ago, when one of the shipping magnates (I take it that he could not have been aware of the fact that we are at war for our national existence) actually gave £8,000 to endow a chair of "Classical Archæology." I say, the money found, a large university would very soon ask to be allowed to start such a scheme—indeed I can foresee the possibility of competition in this direction. Once started other universities would follow suit.

In conclusion, I am hoping to live to see the time when Radiology and Electrotherapeutics, taught at all University and Medical Schools by professors and lecturers, will be carried on throughout the kingdom by well trained, medically qualified specialists and by such men and women only.

NEW TECHNIQUE.

REMOVAL OF STAINS FROM ACCELERATING SCREENS.

By William Mitchell, M.B.

Hon. Physician in charge, Electrical Department, Royal Infirmary, Bradford.

Stains from developing solutions are apt, even with the greatest care, to get on to accelerating screens when being manipulated in the dark room, and I have no doubt many radiologists besides myself have thrown on one side screens damaged in this way and have gone to the expense of getting new ones. For some time I have been experimenting with various solutions in attempts to renovate these stained screens, and have at last succeeded in finding a method which restores them to their pristine newness without in any way impairing their efficiency. In fact, I think their efficiency is increased. It consists in laying the screen face up on a pad of white blotting paper, and then washing the surface over with a swab of cotton wool soaked in the ordinary solution of peroxide of hydrogen. This washing has to be kept up for about half an hour, when the spots will gradually begin to fade away. The more persistent spots may be covered with a little pool of the peroxide solution and allowed to stand a while. After the screen is thoroughly soaked the surface should be dried with a mop of dry cotton wool, and then the screen should be placed inside a pad of white blotting paper of sufficient thickness to prevent it from curling. It may be that this method is already known, but makers have told me these screens could not have developer stains removed. I have treated five screens of different makes in this way with perfect success. Although the stains may not appear to have entirely disappeared while the screen is still wet, they are usually found to have done so when dry. If, however, any stain is still visible then repeat the process. I have not noted any corrosive action on screens thus treated.

NOTES AND ABSTRACTS.

RADIO-DIAGNOSIS.

X-ray Diagnosis of Surgical Complications within the Chest.—(*New York Medical Journal*, June 17th, 1916.)—Pfahler broadly reviews the sphere of radiography in surgical thoracic diseases, and speaks of its utility to the surgeon, not only in primary intra-thoracic lesions but also in indicating an extension to this part of diseases in other regions of the body. Knowledge of such extension is of use to the surgeon in the first place by exhibiting the necessity for extreme care in operating and in the choice of anæsthetic, and in the second place by demonstrating that the disease has spread to such an extent that his intervention can do nothing to prolong life and may even hasten its end.

The lesions are divided into three clasess, according as they are located in the mediastinum, lungs or pleura.

The Mediastinum.

1. *Aneurysm.*—May be present in conjunction with various morbid processes in other parts of the body, and, if not recognised, can lead to serious complications during or after operation. Its presence can almost always be demonstrated by X rays, and this knowledge may influence the surgeon in his choice of operation.

2. *Atheroma of the Aorta.*—Is often associated with various conditions which cause sudden death, and may be recognised by a sharp projection to the left at the beginning of the descending portion of the arch, or by the recognition of calcareous plaques in the thickened artery wall, if a plate be taken in the oblique position.

3. *Mediastinal Tumours.*—May be primary or secondary. It is frequently very important for the surgeon to know if an external tumour, which he is about to remove from such a position as the breast, thyroid, or cervical glands, has any extension into the thorax. Tumours of the mediastinum are:—

(*a*) *Sarcoma.*—Generally primary: usually involves the upper portion of the mediastinum and most commonly extends between the upper and middle lobes of the right lung. It is apt to be irregular in outline.

(*b*) *Lipoma.*—May be very large. Pfahler saw a case in which it was as large as the patient's head, perfectly symmetrical, and did not extend along the inter-lobar furrow.

(*c*) *Carcinoma.*—Nearly always secondary, and most commonly so to a similar condition in the breast extending directly through the chest wall by the lymphatics. The secondary tumours are generally small but occasionally may fill the whole superior mediastinum.

(*d*) *Hodgkin's Disease.*—Enlargement of the mediastinal glands will often serve to differentiate between this condition and tubercular enlargement of the cervical glands, since it is common to find enlarged mediastina glands in Hodgkin's and rare in tubercle. If tubercular glands are present in the thorax at all they are much more frequently in the roots of the lungs than in the mediastinum. In the case of Hodgkin's disease involving both cervical and mediastinal glands a full recognition of the condition may assist the surgeon in deciding to refuse operation, since this disease is nearly always made worse by removal of a portion only of the diseased glands. A marked enlargement of the mediastinal glands by tumours of variable size is, in itself, rather characteristic of Hodgkin's disease.

(*e*) *Enlargement of the Thymus.*—This is specially important in connection with operations for goitre and makes the operation decidedly more hazardous. It may necessitate a preliminary operation for removal of the thymus, or it may sometimes be advisable to reduce the gland by means of irradiation prior to operation. Thymic enlargement is recognised by the presence of an abnormal shadow extending from half to one inch generally to the right, but sometimes also to the left, of the manubrium sterni.

(*f*) *Thoracic goitre.*—A large goitre may extend down into the superior mediastinum and complicate its removal.

The Lungs.

1. *Abscess.*—May develop as a complication of one of the acute infections, especially pneumonia, or may be due to inhalation of a foreign body. The exact location of the abscess can be depicted and surgical interference is usually necessary. The radiographic appearance is that of a cavity surrounded by a sclerotic ring and the level of the contained fluid may sometimes be seen if the patient be examined in the upright position.

2. *Gangrene.*—The exact site and the area of greatest destruction can be seen. There is usually a less definite cavity formation and more extensive consolidation than in simple abscess.

3. *Tumours* of the lungs may be primary and benign but are in most cases secondary and malignant. Their recognition is important in order that useless extensive operations on other parts of the body may be avoided.

Metastases are often found giving rise to no symptoms, and this is especially the case in sarcoma. The radiographic appearance of secondary sarcoma is very characteristic, with its depiction of spherical tumours generally scattered through the lung tissue. As an example Pfahler cites the case of a patient who was sent to him, after removal of a hypernephroma, for post-operative irradiation of the operation field. He examined the chest and found metastases, from which the patient died within two months. Sometimes the appearance of secondary carcinoma is very similar to that of tubercle, but they occupy rather different positions in the lung.

4. *Bronchiectasis.*—There may be either a single large cavity or many small ones, all connected with the bronchial tree. Stereoscopic plates are particularly helpful in these cases.

THE PLEURA.

1. *Effusion.*—Can be recognised easily and its precise level determined if the examination be made in the vertical position.

2. *Empyæma.*—May give the same appearance as serous effusion, but the shadow is usually more dense. If encysted, definitely confined to one part, or interlobar, its precise localization is demanded.

3. *Tumours*—May rarely be primary, but are usually secondary to mammary carcinoma. They are nearly always accompanied by copious effusion, which may mask their true nature.

THE LARYNX, TRACHEA AND BRONCHI.

1. Foreign bodies are the most important and can usually be seen and definitely localized. If they are of a nature invisible by means of the rays, they can often be located by observing in which section of the lung there are changes consequent on their presence.

2. Tumours of the air passages are rare, but they do occur and can be recognised radiographically. Pfahler himself had such a case.

H. M. B.

Pre-operative Roentgenological Examination in Cancer of the Breast.—J. W. LANE (*Boston Medical and Surgical Journal*, August 17th, 1916, p. 232).—The writer states that once a cancer of the breast has formed metastases in other organs, operation is useless. He believes it is therefore necessary to operate before these metastases take place, and that no operation should be undertaken until this dissemination has been ruled out.

Lane advocates as a routine pre-operative procedure the examination, by X rays, of the chest, pelvis, spine, humeri and femora in all cases of suspected breast cancer. It may be urged, he says, that a radical operation relieves suffering and prolongs life even in advanced cases, but, he asks, how much longer actually is life preserved and how much suffering saved than would be the case under skilful medical treatment.

While entirely agreeing with the author in advocating thorough radiographic examination as to the extent of metastases in any case of breast cancer, it is not likely that, if any metastases are found, surgeons or radiotherapists will, for this reason only, advocate the dismissal of operative procedures.

R. W. A. S.

On the Value of Roentgen-ray Examination in the Diagnosis of Cancer of the Stomach.—F. H. BAETJER and J. FRIEDENWALD (*Bulletin of the Johns Hopkins Hospital*, August, 1916, p. 221).—The authors find that X-ray examination offers most valuable assistance as an aid in the diagnosis of gastric carcinoma; and this is especially true when the lesion is situated in the so-called silent area. It should not be relied upon alone in the diagnosis of early cases without a strict consideration of the clinical aspect of the disease, but, when taken in conjunction with the other signs, it is of the greatest diagnostic value.

Indurated gastric ulcers give the same radiographic appearance as carcinoma; but as ulcers are frequently precursors of cancer, they may be grouped for practical purposes in the same class. It is often possible to determine their true nature only by microscopic examination of the excised area.

In the diagnosis of gastric carcinoma two conditions must be taken into consideration; the peristaltic waves and the morphological defect in the stomach.

In carcinoma of the cardiac area of the stomach, the cardiac orifice is almost always affected, and the patient comes for an examination because of difficulty in deglutition. Examination reveals a stricture of the cardiac orifice together with a small or large filling defect in the immediate vicinity. The activity of the stomach itself is normal and, unless the lesion is very extensive, there is no interruption in the peristaltic waves. In lesions in the body of the stomach, one may have an extensive growth, and yet the patient may complain of very few symptoms, as the motor activity is not interfered with. As this lesion rarely affects the cardiac or the pyloric orifice, obstructive symptoms are absent, the stomach emptying at the normal rate or perhaps a little more rapidly than normally. The X-ray examination generally shows that the peristaltic waves are interrupted in their course at the seat of the lesion. In addition a persistent filling defect is almost always present. In pyloric carcinoma there are usually signs of early obstruction in addition to a filling defect of small or large size, according to the extent of the growth.

In carcinoma, unless there be obstruction, there is always hypermotility with rapid evacuation of contents. In ulcer there is hypermotility with pylorospasm, and more or less retention of contents. In carcinoma the filling defect is generally surrounded by an invasive area, interfering with the motility and producing a large dead area, whereas in ulcer the filling defect is much smaller, and is not so apt to interfere with the immediate peristaltic waves.

Radiography furnishes us with important evidence regarding the operability or nonoperability of the growth, indicating the location and extent of the growth, together with the degree of obstruction and the amount of involvement.

Negative findings are at times quite as important as positive ones; if there is an absence of all morphological defects in the wall of the stomach, and the peristalsis is normal, and there is no tendency to even a partial obstruction, carcinoma of the stomach can usually be ruled out. R. W. A. S.

The Influence of Syphilis on the Union of Fractures. — *Interstate Medical Journal*, August, 1916.—Dr. W. Pearce Coues, in the course of an article on syphilis, discusses the influence of that disease on the union of fractures. He quotes, without giving the name of, a surgeon who has said, "For a period of more than a year we made a Wasserman reaction on every un-united fracture, and we did not fail to get a positive result in a single one; there were too many cases to be a coincidence."

He cites several cases from various sources, gives the opinions expressed by different authors, and draws the following conclusions:—

1. Syphilis may cause brittle bones and lead to fracture in an infected person from a degree of trauma which would not cause fracture in a healthy person.

2. Syphilis may retard the union of fractures, and often does so to a marked degree.

3. All cases of fracture with long-delayed or fibrous union should be searchingly examined for syphilis, and the examination should include not only a Wasserman test but also a radiographic study of the other bones.

In support of these contentions he reports the following experiments and cases:—

1. Experimental fractures produced by Charpy on fibulæ from patients who were known to be syphilitic showed a 50 per cent. reduction in their power of resisting fracture as compared with normal ones.

2. A girl, aged 11 years, had a fractured clavicle. After three weeks there was no sign of union. A radiograph of the leg was taken and disclosed marked periostitis of both tibiæ. The child was then put on antisyphilitic treatment, and in a few weeks the bone was nearly solid. Until specific treatment was begun there was no attempt at union, and, incidentally, the condition of the leg bones also improved under the treatment.

3. A man of 35 thought that he had sprained his ankle, and there was a history of slight direct violence. A radiograph showed a subperiosteal fracture in the upper third of the fibula, marked periosteal thickening of the entire bone and osteo-periostitis of the tibia. A definite syphilitic history was obtained and he did well under appropriate treatment. This case shows the effect of slight trauma causing fracture.

4. A fracture of both bones of the leg which gave no sign of union after nine months. A

doubtful specific history was then obtained and intensive mercurial treatment instituted. One month later the bones were solid.

5. An oblique fracture of the tibia was not firmly united after seven months. The man was then found to have tertiary syphilis, and specific treatment was commenced. One month later the bone was solid.

6. A man, aged 25, sustained a fractured tibia, and there was no union after 55 days. Specific treatment was commenced and signs of consolidation were noticed 14 days later; the treatment was then discontinued, and in the following 15 days careful observation showed no more progress towards union. The treatment was then re-instituted, and in three weeks union was complete.

7. A syphilitic woman, of 27, received a fractured femur by a box of dressings being accidentally pressed on her thigh. "It was not at all a heavy box." This again shows fracture from slight violence.

8. A woman, aged 28, sustained a fracture of the clavicle following a violent movement of the arm, insufficient normally to cause fracture. Recovery took place under specific treatment.

9. Another fracture caused by muscular violence in a man, aged 32. The fracture was close to the upper epiphyseal line of the humerus, and the radiograph also showed a previous fracture and rarifying osteitis. The syphilis in this case was probably congenital.

10. A soldier, aged 37, was kicked by a horse, and his tibia fractured. There was also a wound of the soft parts, but it did not lead down as far as the bone. The wound became infected, and eventually bare bone was found. A history of syphilis some years previously was elicited and potassium iodide was administered. In two weeks the wound was entirely healed, and union of the fracture, which had previously been delayed, advanced rapidly.

11. The effect of a specific infection following a fracture is seen in the following case. While in good health a man sustained a broken ankle, which healed with no loss of function, and he worked uninterruptedly for three years after, and then became infected with syphilis. Six years later he had a spontaneous fracture at the site of the original injury.

H. M. B.

CORRESPONDENCE.

To the Editors of Archives of Radiology and Electrotherapy.

THE BRITISH X-RAY INDUSTRY.

Dear Sirs,

I am desired to bring to your notice the fact that a Section of this Association has been formed, enrolling British manufacturers of X-ray and electro-medical apparatus, with the object of improving the status and prospects of that industry by co-operation and research.

It is probably scarcely realised by the general public what a very important part is played in modern medical practice by X-ray and electrical methods. Every hospital of any size has now a more or less elaborately equipped department for such work, and thousands of medical practitioners throughout the Empire devote their entire energies to this class of diagnostic and curative work. The X-ray examination of those wounded in the war has become a matter of routine, such examinations being, in many cases, made actually on the field by the employment of a motor X-ray installation; while the subsequent treatment of convalescent soldiers by electrical methods is daily increasing in volume and importance.

Before the war the major part of the X-Ray and Electro-Medical apparatus used in this country was made in Germany and other foreign countries. Since 1914, however, great strides have been made by individual British manufacturers, and it is hoped that the enrolment of its members as a Section of this Association will further help to place and maintain this important key industry in a position where it can supply not only the home trade but the whole of the Empire. British manufacturers have been at a serious disadvantage owing to lack of co-operation by which to meet the keen competition which existed in the world market. The Section is one comprising practically every manufacturing firm in the business in Great Britain; and its formation would seem, therefore, to offer a means whereby the manufacture of British electro-medical instruments may be systematised and fostered.

Already the Section has been able to cooperate with the Government in research work connected with the improvement of some essential instruments, and it is hoped that this will be only a preliminary to wider investigations.

The Section views most hopefully the future of the X-ray and electro-medical industry in this country, and earnestly invites the cooperation of medical men and hospitals with the object of supporting and strengthening the movement towards the exclusion of foreign-made apparatus. Any practical suggestions from X-ray workers will be most gratefully considered, the aim of the Section being to give such workers an entirely British service of everything required for their use.

Your obedient servant,
D. N. Dunlop,
Secretary.

The British Electrical and Allied Manufacturers' Association,
King's House, Kingsway, London, W.C. 2.

PUBLICATIONS RECEIVED.

Journals.

American Journal of Electrotherapeutics and Radiology, March, 1917.

American Journal of Roentgenology, March, 1917.

American Medicine, March, 1917.

Archives d'Electricité Médicale, April, 1917.

Archives de Médecine et de Pharmacie Militaires, Jan., 1917.

Boston Medical and Surgical Journal, April 5th, 12th, 26th, 1917.

British Journal of Dermatology and Syphilis, Jan.-March, 1917.

British Journal of Surgery, April, 1917.

Interstate Medical Journal, April, 1917.

Journal of the Röntgen Society, April, 1917.

Journals—*continued.*

Medical Journal of Australia, March 10th and 17th, 1917.

New York Medical Journal, April 14th, 21st, 28th, and May 5th, 1917.

New York State Journal of Medicine, April, 1917

Pacific Medical Journal, April, 1917.

Policlinico, Il., April, 1917.

Revista Española de Electrologia y Radiologia Médicas, Jan.-March, 1917.

Royal Society of Medicine, March and April, 1917.

Southern Medical Journal, April, 1917.

Ugeskrift for Læger, April 12th and 19th, 1917.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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A CASE OF TRAUMATIC DISLOCATION OF THE RIGHT HALF OF THE PELVIS.

By C. H. S. Webb, M.S., F.R.C.S., Capt. R.A.M.C. (T.C.)

WITH

A NOTE ON THE SKIAGRAPHIC APPEARANCE OF THE PELVIS.

By F. R. Snell, M.B., B.S., Capt. R.A.M.C. (T.C.).

The rarity of this condition induces us to place the following case on record :—

The patient, a private in the Manchesters, aged 27, was standing half in, half out of a dug-out, when a shell blew in the dug-out, burying the patient under a mass of debris.

He remembers little or nothing of the accident, save his position before the dug-out fell on him and his being removed to hospital.

He was standing with his right foot two steps down the dug-out stairs and his left foot just outside. He was leaning outwards and looking upwards over his left shoulder.

The roof of the dug-out entrance contained corrugated iron and a large baulk of timber, which presumably fell on him. He remembers nothing more.

He was admitted to the Casualty Clearing Station with the diagnosis of "Crushed Chest" (?) internal injury. He complained of pain in the hypogastrium and in the sacral region. He said he had passed blood in his water. He had not vomited, nor did he complain of pain in the abdomen, other than that over the pubes. He was pale and in pain, but otherwise quite cheerful.

There were no abrasions on the skin whatever.

On examination there was tenderness over the pubic region, along the right Poupart, and continued along the whole of the crest of the ilium back to the sacro iliac synchrondrosis. At the back over the sacrum there was considerable swelling. Later this showed the characteristic colour changes of extravasated blood.

On deep pressure over the pubes, the right pubic crest was felt to be displaced upwards and backwards, this upward displacement measuring about $\frac{5}{8}$ in.

There were signs of extravasated blood in the right groin, spreading upwards in the direction of the right anterior superior iliac spine, downwards a short distance below the Poupart's ligament, and upwards towards the umbilicus. This swelling and discolouration, in conjunction with the hæmaturia which was present, gave rise to the suspicion of urinary extravasation, but he had no difficulty in micturition other than a little pain at the end, and the average daily amount of urine passed was 48 ozs. The swelling did not increase, and in three days showed the colour changes of a bruise.

The highest point of the right iliac crest was $\frac{3}{4}$ in. higher than the left side.

Behind, the posterior superior iliac spine was easily palpable as a prominence situated on a plane posterior to the sacral spines and raised $\frac{3}{4}$ in. backwards. (These posterior measurements were obscured by the presence of the sacral hætoma, and should be regarded as approximate.)

Traction applied to the right leg produced definite movement of the right half of the pelvis, small in amount, though easily appreciable.

There was no alteration in the femoral pulse or in that behind the ankle.

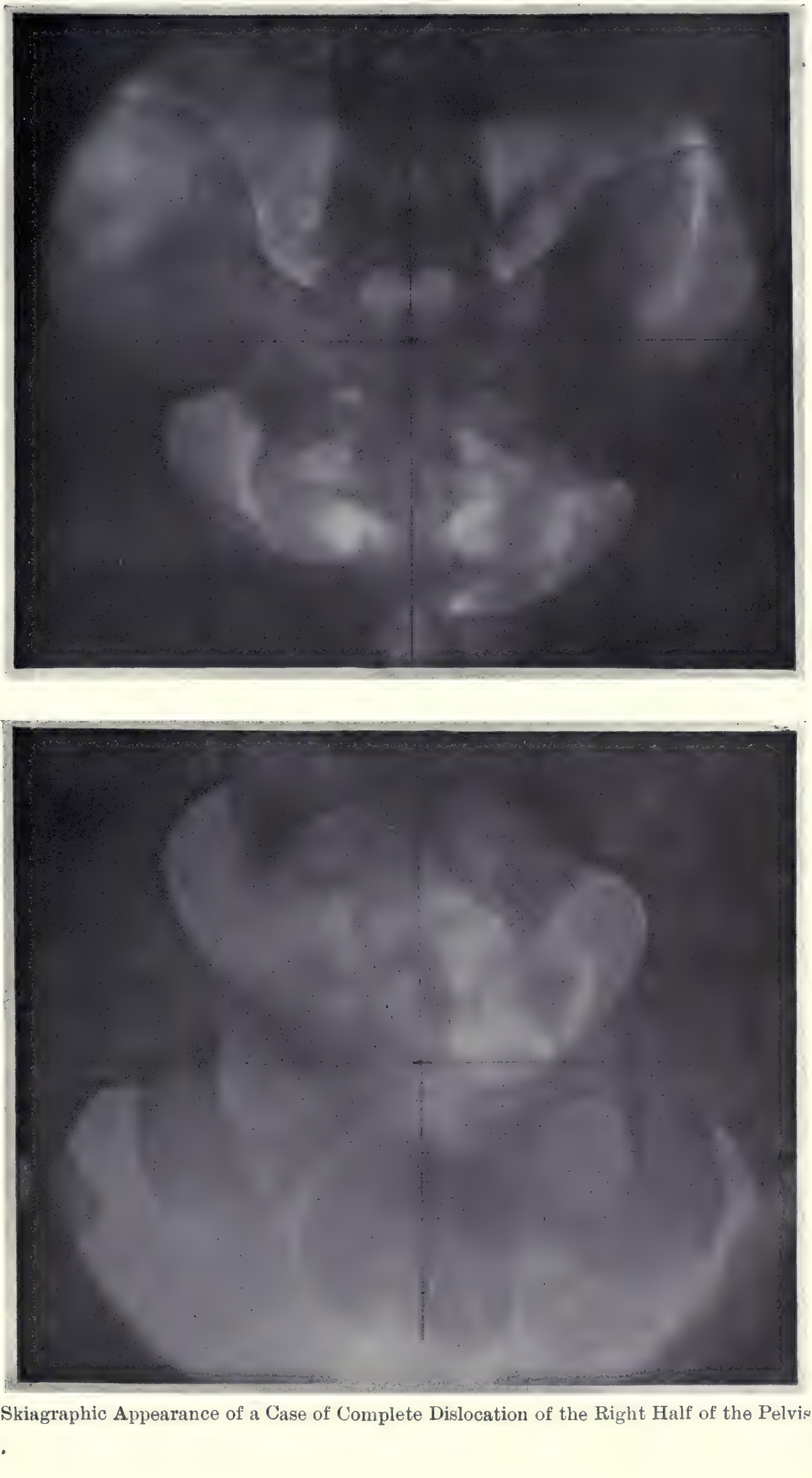
There was no paralysis, paræsthesia, or referred pain along any particular nerve.

Voluntary or passive movements of the thigh caused pain at the back over the sacro iliac synchrondrosis and in front over the pubes.

On admission, the patient stated that he had passed blood in his urine, and this was confirmed by a specimen that he passed soon after admission, the urine containing enough blood to produce a dark smoky tint.

This hæmaturia disappeared in three days.

On the third day a simple enema produced a normal result. There was



Skiagraphic Appearance of a Case of Complete Dislocation of the Right Half of the Pelvis.

PLATE 3.

no blood in the motion and no pain in defecation. Rectal examination disclosed no injury to the rectum.

A diagnosis of fractured pelvis was made, and the accompanying skiagrams were then taken by Captain Snell. They established the diagnosis of dislocation at the symphysis pubis and at the sacro iliac synchrondrosis.

As will be seen from Capt. Snell's description of the plates, it seems a pure separation of the joint surfaces not complicated with fracture. A small fissured fracture occurs in the ascending ramus of the right ischium, and is of secondary importance to the main injury.

The patient was discharged to the Base, and has since been heard of as doing well in England.

Note on Skiagraphic Appearance.

X-ray Report on Case of Complete Dislocation of Right Side of Pelvis.

This case, on reference to the accompanying prints, at once manifests itself as one of unusual, if not unique interest, not merely from the point of view of the obvious dislocation, but the marked degree of the displacement of bony parts of the whole right half of the pelvis, without any fracture of consequence relative to the displaced parts.

The most conspicuous feature at first sight is the wide gap between the pubic bones, the left one, although intact, having lost the support of the apposing half, has receded to the left side $\frac{5}{8}$ in. from the middle line. The right pubic bone has receded a precisely similar distance to its own side also, producing a resulting gap $1\frac{1}{4}$ in. wide, as shown in the prints, but the greatest displacement of all is seen between the two upper borders of the symphysis, where the distance equals $1\frac{3}{4}$ in. separation

On viewing the right sacro iliac synchrondrosis, this is found no longer to exist, the lower part of the iliac bone being 1 in. above the corresponding attachment of its own synchrondrosis ; the upper articular surface of the same bone is the same distance above the upper bower of the sacrum.

The only measurement which at first sight appears unaltered is the distance of the posterior part of articular surface of ilium from the middle line; being exactly the same as on the sound side. But in reality this part of the ilium is behind the right wing of the sacrum, which bone is perfectly normal in position and is intact.

As all the abnormal relationships of these bones are out of the true to the same extent, it is perfectly clear that this is a case of complete backward and upward dislocation of the entire right half of the pelvis. The fracture of the ascending ramus of the ischium amounts to little more than a mere crack, and in no way affects the dislocation pure and simple.

SKIN INK.

By Capt. N. S. Finzi, M.B., 1st London General Hospital.

The radiologist has long been troubled by the careful and thorough way in which some nurses endeavour to remove his localisation skin marks immediately on the patient's return to the ward, consequently the need for a substance which will make an indelible mark on the skin, proof against rough treatment, has been acutely felt in this war.

The properties required in such a substance are as follows:—

(1) It should stain the skin such a colour that it will show up against iodine.
(2) The mark should be unaffected when rubbed with spirit, acetone, ether soap, or tincture of iodine.
(3) The mark must last, when covered up with dressings, at least 5 days, and longer if possible.
(4) The mark should be quickly and easily made, and making it should not hurt the patient, for it must be frequently placed on a part that is acutely inflamed and tender.
(5) The substance used for the mark must not damage or inflame the skin.
(6) It should be possible to see the mark immediately it is made.
(7) The materials used must be obtainable.

Condition (4) practically requires the use of a liquid applied with a brush, as the pressure of a pencil will often cause considerable pain. The liquid should penetrate the skin well and evaporate quickly, so that watery solutions are ruled out, and it is advisable, in order to save time, to have a single-solution marking fluid.

Silver nitrate forms a good mark, but it turns white with iodine and is not easily seen. It cannot be seen when first applied, it must be used in aqueous solution, and it causes a good deal of inflammation even, sometimes, when it is developed *in situ* by photographic developer. This substance cannot, therefore, be regarded as at all suitable.

I have experimented with a number of dyes without finding a thoroughly satisfactory one. A solution of ferric chloride in alcohol, followed by a solution of hæmatoxylin in alcohol and ether, as suggested to me by Capt. C. E. S. Phillips, formed a satisfactory mark, but being in two solutions took some time to apply, and, as hæmatoxylin is no longer obtainable, it need not be further considered. The least unsatisfactory aniline dye was a solution of methyl violet [1] in acetone and water 50 per cent., followed by a painting with tincture of iodine. Aniline green also gave a fairly satisfactory mark when applied in the same way.

I eventually found that ferric chloride, followed by pyrogallic acid, gave a grey mark, which gradually turned a fine black after five or six hours, and this mark lasted more than double as long as the iron-hæmatoxylin mark mentioned above when exposed to the same conditions. Further, the mark was unaffected by iodine, acetone, ether soap, etc., and could, in fact, be scrubbed with a nail brush and ether soap two days after it was made without being completely removed.

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[1] The ordinary indelible pencil appears to contain this dye.

Experiments were next carried out in order to obtain the fluid in one solution, and it was found that a mixture of the two solutions was quite satisfactory, and seemed to keep well, showing no great tendency to oxidise, even when kept in an open test tube; this is possibly due to a small amount of acid in the "liquor ferri perchlor." from which it was prepared. The next points to find out were a satisfactory concentration, and the best proportion of the ingredients. The latter was determined by painting the skin with a mixed solution of known constitution, and then, when dry, painting marks on it of solutions of pyrogallic acid and ferric chloride respectively. If one or the other improved the result the mixture was amended accordingly. The former point was disclosed by a series of comparative marks with different strengths.

Different skins seem to vary in the degree to which they take stains, and as to the durability of the resulting marks. Experiments with different solvents showed that acetone and methylated spirit gave little difference in result on my own skin, the latter, however, was better than rectified spirit. Owing to the fatty nature of some skins it seems advisable to make the fluid, at any rate in part, with acetone, though, if this is not obtainable, methylated spirit may be substituted.

The formula I finally arrived at was :—

Acid pyrogallic	1 gram.
Acetone	10 cc.
Liquor ferri perchlor. *fort.* ...	2 cc.
Sp. vini meth. ad.	20 cc.

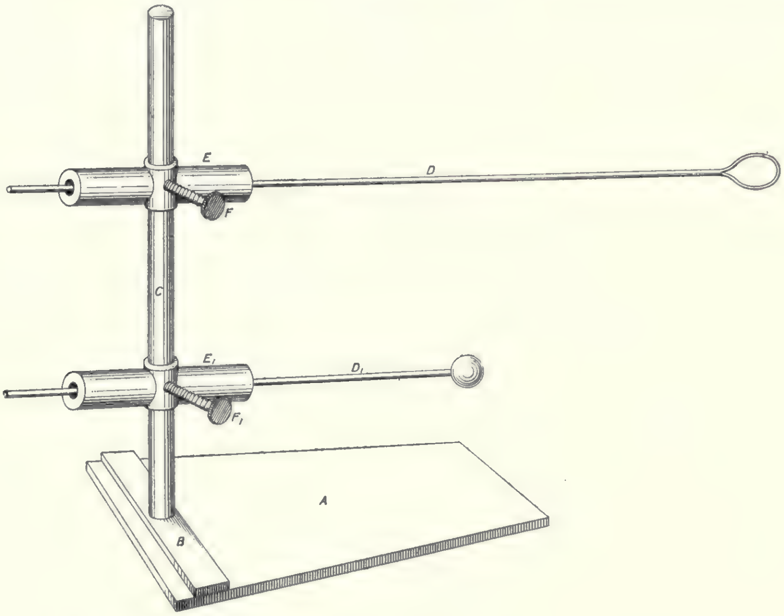
This gives a concentration of 5 per cent. pyrogallol and 2 per cent. Fe. The solution is best kept in a bottle with a camel's-hair brush attached to the cork so that it can easily be painted on. The mark is a brownish-grey at first, but after a few hours turns a brilliant black. It fulfils the conditions set forth above.

A SIMPLE METHOD OF LOCALIZATION OF FOREIGN BODIES.

By Dr. J. S. Young, St. Louis, Missouri, U.S.A.

One of the most important subjects to my mind, concerning the medical and surgical work in Europe at present, is the question of accurately locating foreign bodies, and being able to do this with as little expense attached to it as possible, for radiographic work is most expensive at the very best.

At present there are many methods being used. I might mention the "Suilte" and "Mackenzie-Davidson" methods, etc., and others, which are all good. But the method which I am employing at the present time is to my mind the most simple and the most accurate.



A = Aluminium Base (underneath patient).
B = Support for upright standard.
C = Upright standard.
D = Rod with loop; locate perpendicular.
D_1 = Rod with ball; locate base. Right angles to perpendicular.
E = Cuff through which perpendicular localiser passes.
E_1 = Cuff through which horizontal localiser passes.
F = Adjusting screw to fasten perpendicular localiser.
F_1 = Adjusting screw to fasten horizontal localiser.

This consists simply of a small apparatus, with an aluminium base, which rests underneath the part which contains the foreign body, and an upright standard which rests upon the broad end of the aluminium base. This standard has two adjustable cuffs—an upper and a lower—through each of which passes a rod. The upper rod has a loop on its end, while the lower has a small metallic ball. These rods are both adjustable in two directions, and are secured by two set-screws. (See diagram.)

The patient is placed upon the aluminium base (tube of course underneath table), foreign body is located by the central rays, and loop is pressed directly over the same. After having pressed the loop on upper rod close to the skin so that there will be no motion, the diaphragm is then opened and the tube moved up and down, and the ball is then adjusted so that it moves in the same plane with the foreign body. The foreign body is thus located in two directions, the ball locating it at the base line, and the loop locating it in the perpendicular plane.

There may be others who are using this method without an aluminium base upon which the patient or part rests, but there is always a chance of slight displacement unless the localizer is held in position by the patient.

This method of course has its faults—or, I should say, one can make mistakes. The method is perfectly simple and is absolutely correct, if the operator is careful first in posing his patient, and second in observing that the foreign body and ball move in the same plane. Otherwise he will find there is a variation of from half an inch to two inches in the lower plane of his localization.

ROENTGEN OBSERVATIONS ON THE DUODENUM, WITH SPECIAL REFERENCE TO LESIONS BEYOND THE FIRST PORTION.

By James T. Case, M.D., F.A.C.S., Battle Creek, Mich.

(Continued from p. 19.)

Duodenal Obstruction.—Reference must be made to the theory of Lane's duodeno-jejunal kink, and its relation to the causation of duodenal ulcer. For present purposes it may suffice for the writer to state his unbelief that the so-called kink, which one can demonstrate in a great many patients at the duodeno-jejunal junction, has any definite or constant relation to duodenal obstruction. That such an obstruction occasionally occurs is, of course, understood, but the writer cannot believe that it is a common finding. Various others have advanced theories regarding the causation of duodenal stasis, as, for instance, by drag of the mesentery across the third portion of the duodenum (so-called mesenteric ileus).

The writer would only call attention to the fact that the so-called "writhing duodenum," believed by Jordan to be pathognomonic of duodenal obstruction, is demonstrable in almost every thin patient when examined in the supine position and with the large opaque meals given by Jordan. It should further be remembered that the appearance of normal peristalsis in the duodenum may simulate obstruction, especially if one depends upon roentgenography alone. A true duodenal obstruction should be demonstrable on repeated examination, and should seriously interfere with the passage of material past the seat of hindrance. Many cases of so-called "writhing

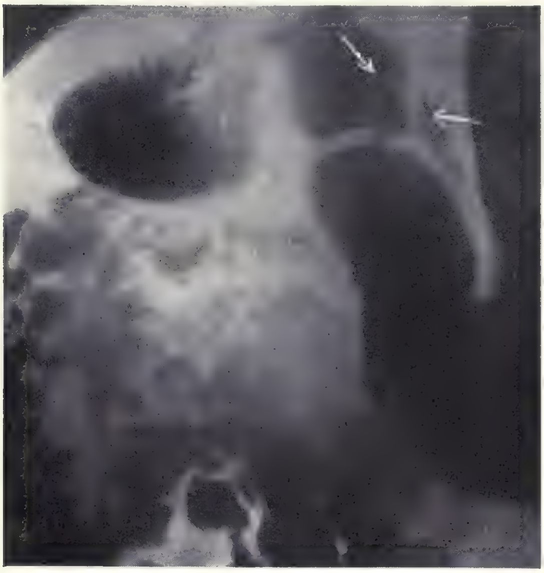


Fig. 2.—Marked Distension of the Duodenum, Patient Lying Supine.

The duodenum is widely filled, owing to saddling of the gastro-duodenal shadow over the spine. A duodenal ulcer is shown at arrows, but there was no duodenal obstruction and no duodenal or gastric stasis. With the patient lying upon the face or standing there was no duodenal distension.

duodenum," supposed to be due to obstruction at the duodeno-jejunal junction, exhibit also early filling of the upper small bowel and such extensive and complete distribution of bismuth throughout the entire small intestine, with clearance of both the stomach and duodenum within the normal time, that one cannot entertain the idea of obstruction. Cases of true duodenal obstruction (below the pars superior) have been encountered only rarely in the writer's experiences—not over twenty or twenty-five instances. These cases have, for the most part, been associated with ulcer or carcinoma on the posterior wall of the stomach, with adhesions involving the duodenum or the jejunum in the neighbourhood of the duodeno-jejunal junction.

One must exercise great care and judgment to distinguish duodenal stasis and duodenal dilatation from wide filling of the third portion of the duodenum, especially if the patient is examined in the supine position upon the horizontal fluoroscope, for in this position, especially when the patient is poorly nourished, the duodenum saddles over the spine in such a way as to make a certain degree of obstruction at the duodeno-jejunal junction. This causes the appearance of alternating onward and retrograde peristalsis in the duodenum similar to that described by Jordan as "writhing duodenum," which he considers pathognomonic of ileac stasis. These cases of pseudo-duodenal obstruction, or even functional duodenal obstruction, may be differentiated from the organic obstruction by the fact that they are seen only with the patient in the supine position, whereas the organic obstructions are evident in all positions. This unusual visualization of the duodenum may

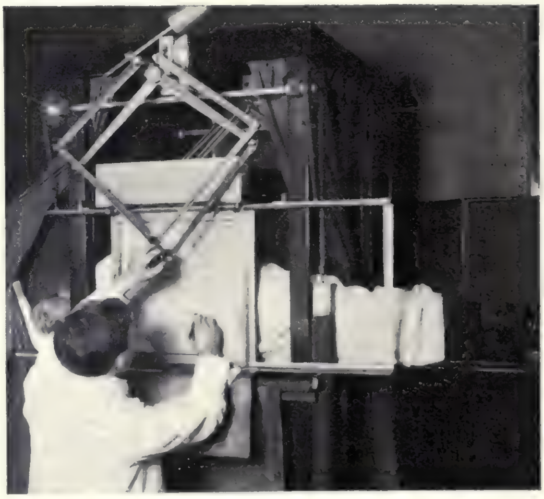


Fig. 3.—An Illustration of the Right Lateral Position, Screen held Vertically in front of Patient.

This position is especially valuable in studying the duodenum and pyloric end of the stomach. (See Figure 12.)

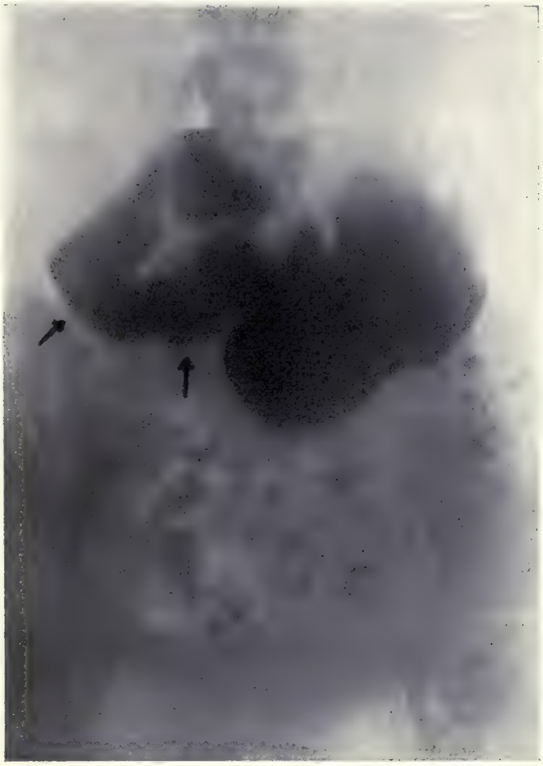


Fig. 4.—Duodenal Obstruction, due to Adhesions Attending Ulcer on the Posterior Wall of the Stomach near the Pylorus; Patient Erect.

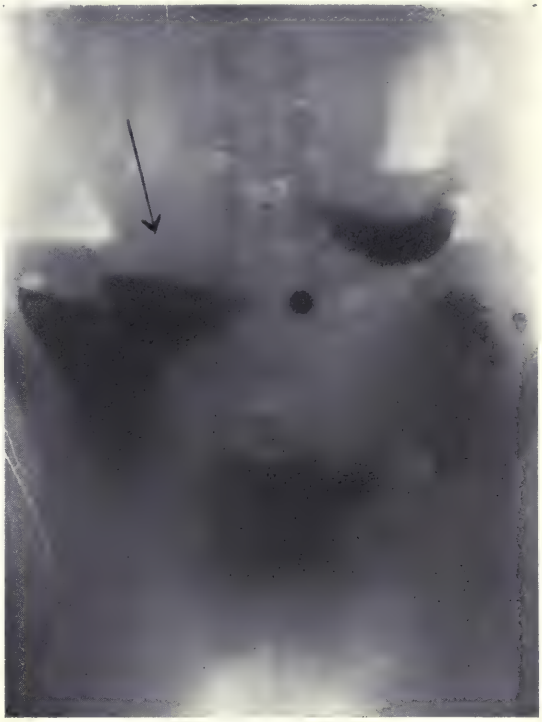


Fig. 5.—Same Case as shown in Fig. 4, but six hours later; Patient Erect.

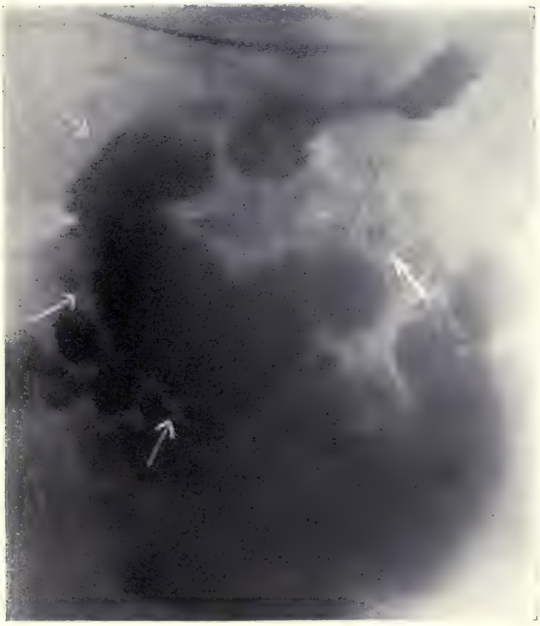


Fig. 6.—Extensive Carcinoma of the Stomach, with Perigastric Involvement near the Duodeno-Jejunal Junction, with Pronounced Duodenal Obstruction and Dilatation.

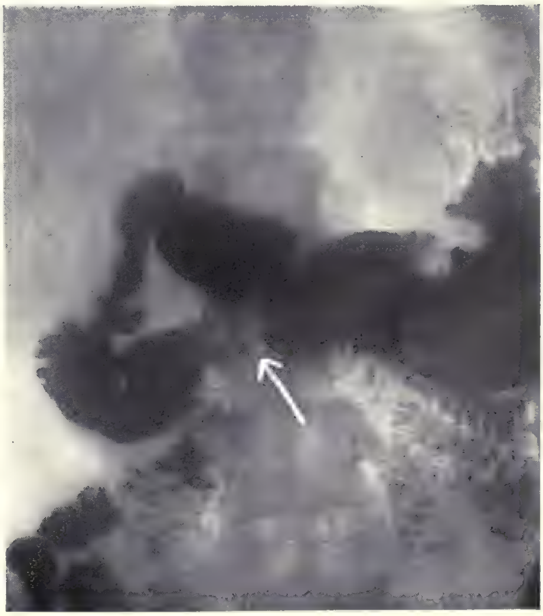


Fig. 7.—Duodenal Obstruction, due to Adhesions near the Duodeno-Jejunal Junction.

No ulcer demonstrable. Ten hours required for emptying duodenum. Relieved by dividing adhesions.

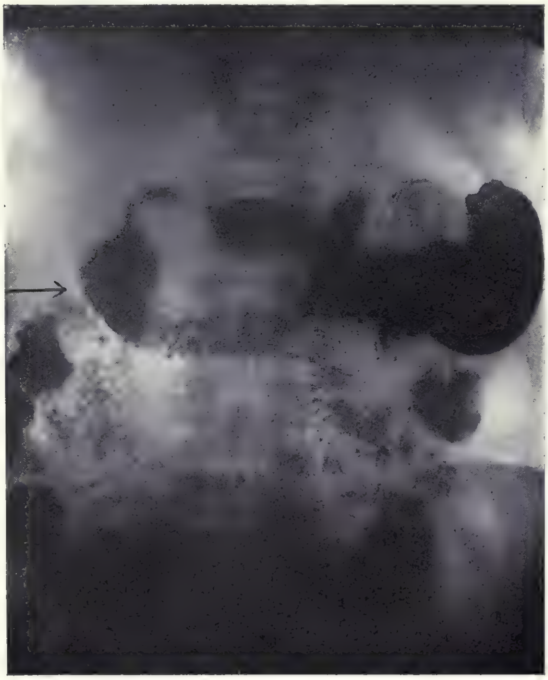


Fig. 8.— Physiological Appearance of the Active Duodenum, which might simulate Duodenal Obstruction.

A bolus of food is being passed along the duodenum by peristalsis.

be due, not to a spastic hindrance, but to too rapid delivery of gastric contents into the duodenum through pyloric insufficiency. This insufficiency may be associated with achylia or duodenal ulcer, or it may be due to adhesions or induration about the pylorus. When the duodenum is unusually filled under these circumstances, one rules out obstruction at the duodeno-jejunal junction if there is free filling of the first part of the jejunum. If the patient has been resting upon the right side for a few moments preceding the fluoroscopic observation, or preceding the roentgenographic record, one is likely to find the duodenum unusually filled.

Duodenal obstruction may occur in connection with a rare anomaly of the head of the pancreas. Normally the head of the pancreas may involve a portion of the wall of the second part of the duodenum, but in certain rare cases the overlying is so great that the whole circumference of the bowel is enclosed by pancreatic tissue. This anomaly may result in obstruction, either congenital, or later in life as the result of inflammatory changes or tumour invasion. In one instance, reported by Symington, the circumference of the distended duodenum where it was surrounded by the pancreas was two and a half inches, while above and below this point it was more than three times as large.

The writer considers that very seldom indeed do adhesions between the gall bladder and the duodenum result in duodenal obstruction. On the contrary, it

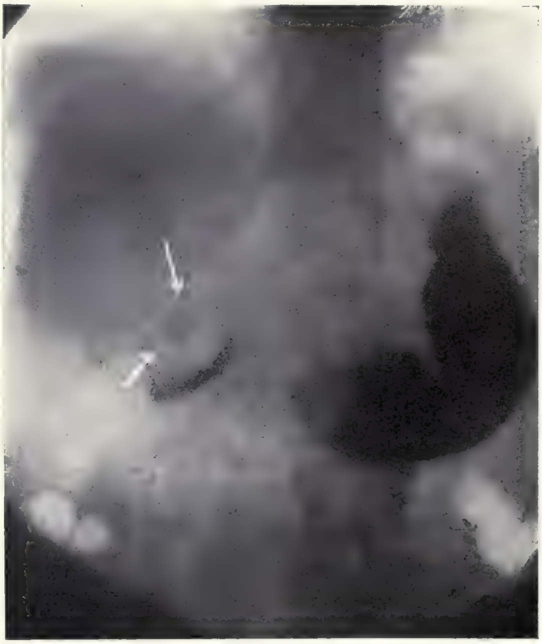


Fig. 9.—A Case of Cholelithiasis with Pericholecystic Adhesions involving the Duodenum.

Gall stones shown at arrows adjacent to the visualized adherent duodenum.

seems that in most cases the emptying time of the stomach is unusually short. These adhesions are not always confined to the first portion of the duodenum ; they sometimes involve the duodenum extensively, producing a characteristic deformity, which can be recognized by careful palpation under fluorescent screen guidance. When, as occurs in many fortunate cases, the gall stones contain a sufficient portion of opaque salts, there is added accuracy to the roentgen findings.

Carcinoma of the Duodenum.—The writer has recognized only one case of carcinoma of the duodenum. This was a malignant tumour located about the papilla of Vater, which was easily recognized by the special method of duodenal examinations described above. In a case personally reported to the writer by Lippmann, the findings were exactly identical, the tumour being located in the papilla of Vater, and being discovered with a similar technique.

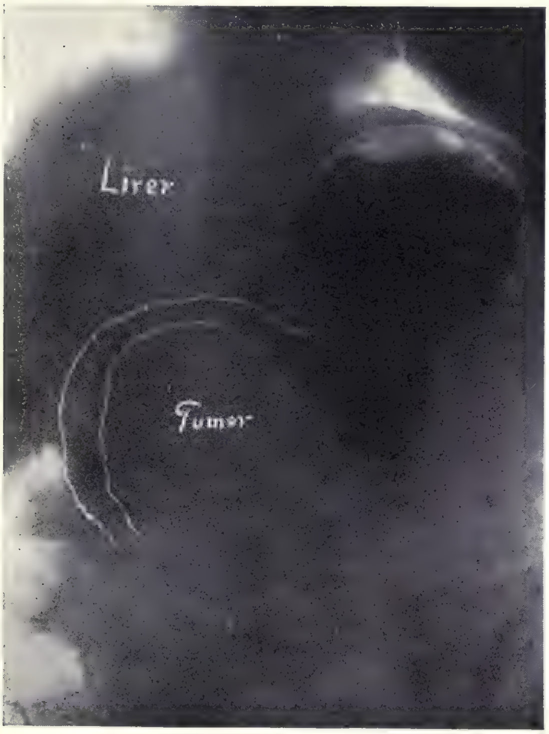


Fig. 10.—Traced Roentgenogram Illustrating Displacement of the Duodenum Upward and Toward the Right in a Case of Tumour of the Head of the Pancreas—in this instance a large Pancreatic Cyst.

Operated upon by Dr. A. E. Halstead (See Fig. 11.)

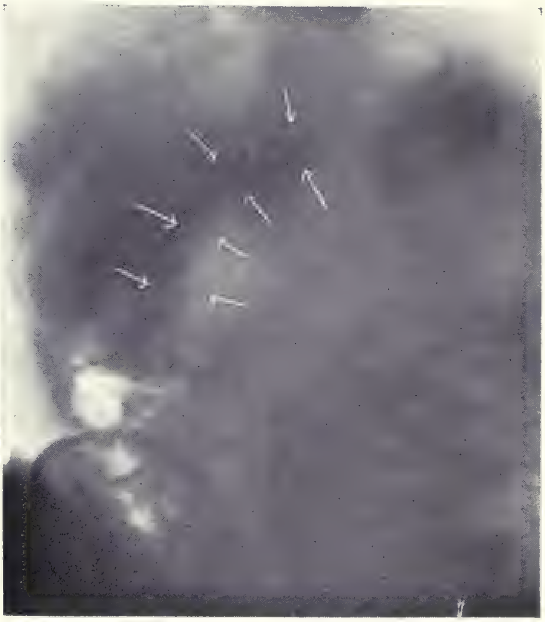


Fig. 11.—Roentgenogram of the same Case shown in Fig. 10, two hours after the Meal.

The thin shadow of the dislocated duodenum is shown at the arrows.

Ulcer.—Ulcer of the duodenum, beyond the first portion, is of relatively rare occurrence, but with the technique described it should be demonstrable. No cases have been recognized in the writer's work.

Differential Diagnosis Between Cholecystic and Pancreatic Tumour.—A. W. Crane long ago called attention to the fact that an enlargement of the head of the pancreas might be inferred from studies of the duodenum. By employing a modification of Crane's technique, the writer has, during the last few years, been able, in a few cases, to make a diagnosis of tumour of the head of the pancreas. Sometimes the distortion of the duodenal loop may be utilized in differentiating between a tumour of the head of the pancreas and a tumour of hepatic or cholecystic origin, as will be illustrated by the following case:—

Male adult, Syrian, with a tumour in the right upper quadrant, was referred by Dr. A. E. Halstead for differential diagnosis. Underneath the right costal margin could be felt a rounded, partially compressible tumour, larger than one's fist. During inspiration the tumour seemed to move up and down. By compression its size could be diminished by one-third. Study was made in view of the possibility of parasitic disease, but nothing was found. By exclusion, the diagnostic possibilities were finally reduced to a distended gall bladder or a pancreatic cyst.

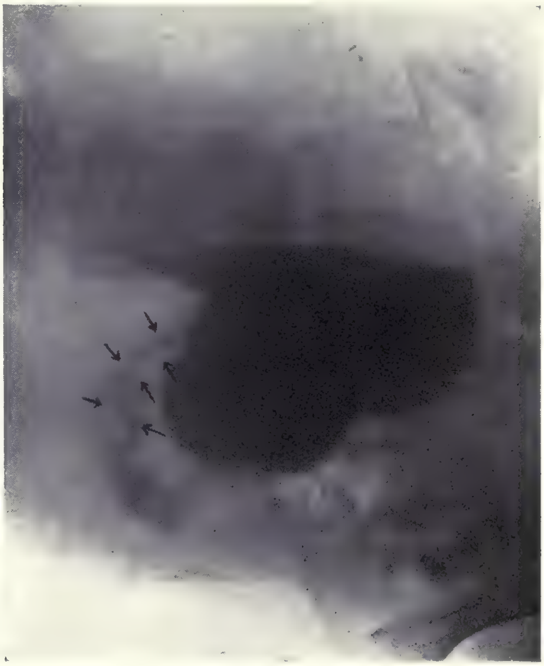


Fig. 12.—Roentgenogram made in the Right Lateral Position, Patient Lying upon the Right Side, Plate Held Vertically in Front of Patient, Tube Posteriorly (See Fig. 3).

The duodenum is shown as a thin shadow, owing to compression by carcinoma involving the pancreas, gall bladder and pyloric end of the stomach.

After the patient had taken a few swallows of barium, it required only a brief glance at the fluorescent screen to decide that the tumour was pancreatic instead of cholecystic. The duodenum was pushed upward and outward to the right in such a manner as to indicate clearly a tumour of the head of the pancreas. At operation Dr. Halstead evacuated a large pancreatic cyst (Figs. 10 and 11).

In a similar case of query between cholecystic and pancreatic tumour, the diagnosis was clearly made in favour of the former, because the duodenum was displaced downward away from the liver in such a way as to suggest a large gall bladder. At operation by Dr. L. L. McArthur there was found abundant evidence of malignant disease, with enormous distension of the gall bladder and secondary involvement of the liver.

The writer has observed that whenever for any reason the pancreas is involved, there is quick clearance of the stomach after a barium meal, and unusual visualization of the duodenum. An exception must be made, of course, where there is a cicatricial or mechanical obstruction at the pylorus or in the duodenum. For instance, in cases of penetrating ulcers on the lesser curvature, which involve the pancreas, the stomach empties quickly. In pancreatic carcinoma with adhesions to the duodenum, the stomach empties quickly, perhaps here on account of achylia. In several cases of duodenal or jejunal diverticula with penetration into the pancreas, gastric motility has been characterized by early clearance.

Duodenal Diverticula.—Real diverticula of the duodenum are of rare occurrence. One occasionally finds a sort of diverticulum associated with the scar of duodenal ulcer, or with pericholecystic adhesions, but these occur in the first portion of the duodenum. The ampulla of Vater is a sort of duodenal diverticulum, as its name would indicate. The writer has observed eight cases of real diverticulum of the duodenum, occurring in the pars inferior. The following are the details of one case :—

The patient, female, age 45, applied for treatment for a pain of six years standing, located in the lower dorsal region. The pain was constant, and of late more intense, increased by lying down, and by making pressure over the abdomen or over the spine. Vomiting was a frequent symptom.

Roentgen examination revealed an unusually large barium fleck (the size of a filbert) in the ampulla of Vater, persisting for about nine hours, and a definite diverticulum of the duodenum in the pars inferior. This diverticulum was ovoid, measuring 2·5 by 5·0 cm. It retained food a little longer than the time required for emptying the stomach (six hours). There was very definite tenderness on accurate pressure over the head of the diverticulum, which occurred upon the mesial side of the duodenum, and seemed to have a relation to the head of the pancreas. The other X-ray findings in the bowel were inconsequential. The X-ray findings, together with other clinical data in the case, led to the diagnosis of chronic pancreatitis, possible gall stones, and a diverticulum of the duodenum (see Fig. 13).

At operation by Dr. J. H. Kellogg the gall bladder was drained, the appendix removed, the incompetent ileocæcal valve repaired, and the stomach and duodenum carefully examined. The diverticulum was found 5 cm. above the duodeno-jejunal junction, in the third part of the duodenum. The diverticulum extended upward behind and into the substance of the head of the pancreas and lay in close approximation to the superior mesenteric vessels. The connection of the diverticulum with the pancreas was so intimate, and the surroundings so vascular, that it was not thought wise to remove it, especially since the patient's symptoms seemed to be due to a chronic pan-

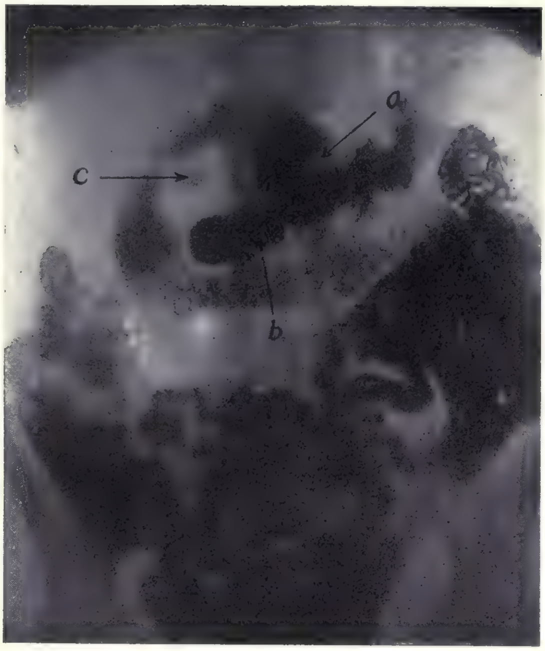


Fig. 13.—A Large Diverticulum of the Third Portion of the Duodenum.

(*a*) Pylorus, (*b*) Diverticulum, (*c*) Visualized Ampulla of Vater. Operated Case.

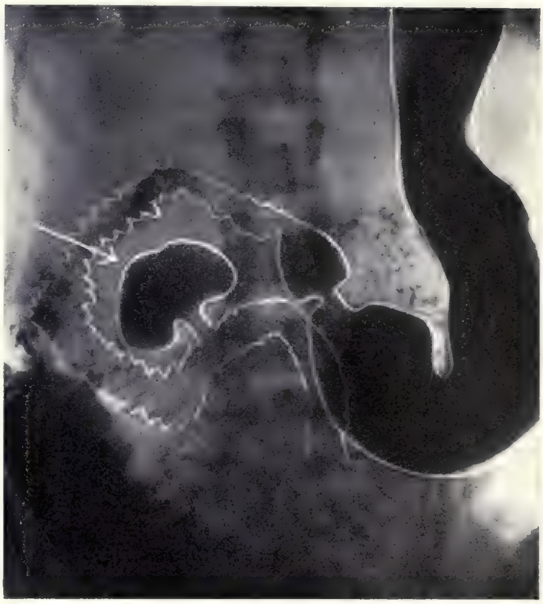


Fig. 14.—Large Diverticulum of the Third Portion of the Duodenum.

Traced roentgenogram from same plate shown in Fig. 15.

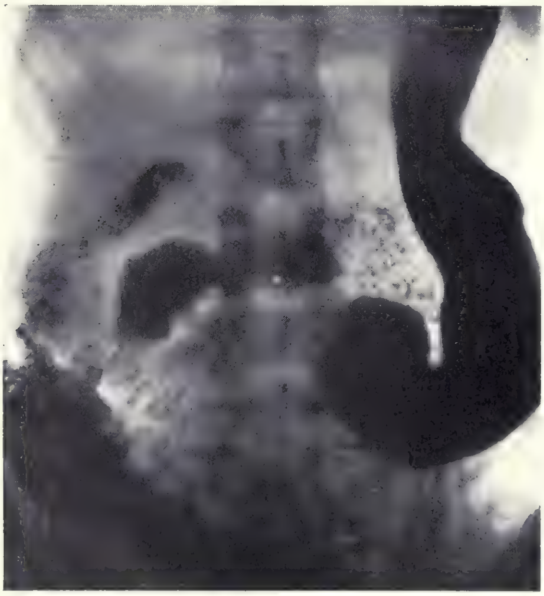


Fig. 15.—Same Roentgenogram shown in Fig. 14, but without Tracing.

Operated Case.

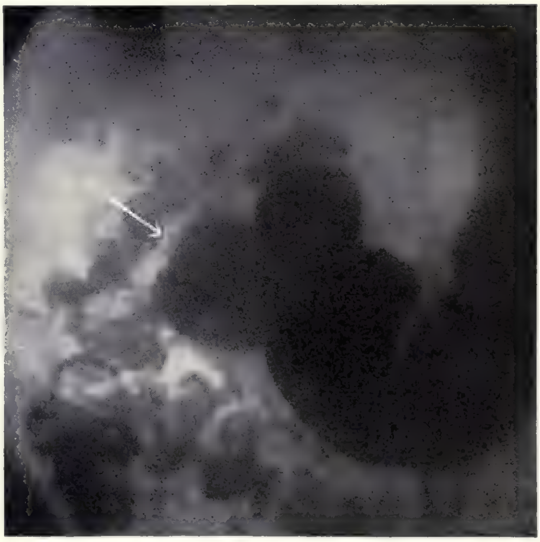


Fig. 16.—Enormous Diverticulum of the Third Portion of the Duodenum shown at Arrows.

Operated Case.

creatitis, and not to the diverticulum itself. The head of the pancreas was somewhat enlarged. At the last report, six months after the operation, the patient had remained free from the severe pain which first suggested pancreatic disease.

The first duodenal diverticulum was reported by Morgagni, in 1761. Occasional references to this condition are encountered in the literature, especially by Roth, Schueppel, Pilcher, Hansemann, Hodenpyl, Keith, Jackson and Baldwin. Baldwin, in 1911, collected in the literature and reported from his own observations eighty-two cases of duodenal diverticula. In many instances, the diverticula seemed to involve or take the place of the diverticulum of Vater, but in about half the cases the diverticula were entirely independent of the bile and pancreatic ducts, and in eighteen cases they occurred in the pars inferior. In twenty-one of the eighty-two cases the diverticula penetrated into the head of the pancreas. In many instances, from the description it is difficult to determine that the diverticula were not enlargements of the normal ampulla of Vater. Indeed, Keith reports a case of ptosis of the duodenum in which he considered that traction upon the common bile duct had produced a large diverticulum of the duodenum at the major papilla. It is noteworthy that in only a few of the cases of duodenal diverticula were there any clinical signs of an inflammatory process.

(To be continued.)

REPORT OF SOCIETY.

THE MANCHESTER AND DISTRICT RADIUM INSTITUTE,

THE ROYAL INFIRMARY, MANCHESTER.

A Report of the Work from January 1st, 1916, to December 31st, 1916.

By ARTHUR BURROWS, M.D., Radiologist.

THIS report deals with the first thousand cases which have presented themselves at the Manchester and District Radium Institute with a view to radium treatment. It represents practically two years work.

Although in the case of malignant diseases no patients are treated by radiation unless the surgeon has previously declared them to be inoperable, a certain number of those who came for consultation were suffering from the disease in far too advanced a stage to hope for any benefit from the application of radium. In addition, some who were deemed suitable for the therapeutic employment of radium did not keep their appointments when their turn for treatment arrived.

Included in the report, in addition to a general table of all the cases which have been treated, is also a list of all the malignant cases, excepting rodent ulcers, which were well at the end of 1916. This list states the time during which they have been quite free from symptoms or signs of disease.

As the Institute has only been open for two years, no patient can have experienced a period of freedom for more than twenty-four months. In addition to this no case of carcinoma of the breast was reported as being apparently well at the end of last year. Thus, in this particular instance, twelve months is the maximum period during which any patient previously suffering from the disease can have been free from symptoms.

In order to make the records as instructive and valuable as possible, practically all the patients have been written to regularly to ensure their attendance at the Institute. As is inevitable, however, even in these circumstances, a number have not returned for re-examination, and it has been necessary to put them under the heading of "Abandoned treatment." That these cases are not all failures is evident from the fact that now and again a case will reappear, either quite well or because there is a return of a symptom which had disappeared. This is particularly noticeable in respect to patients suffering from small rodent ulcers, as a single treatment often removes all manifestations of the growth, and the patients' thoughts are no longer fixed upon their trouble.

During the year the physicist, Mr. Lupton, has been employed for part of his time on munition work at the University. This, coupled with the fact that the present is a difficult time to construct a Research Laboratory, has limited the energies of the Institute to the purely clinical side of its work; but it is hoped that as soon as circumstances permit, an increase in the scope of its activities will be possible.

Mr. Lupton reports that 777 ordinary emanation tubes, 238 emanation tubes for needles, and 316 flat emanation applicators were made during the past year in the physical laboratory. This shows an increase of 251 over the year 1915.

The decrease in the number of patients registered is accounted for by the long waiting list which was in existence when the Institute was opened. That the work has really increased is shown by the larger number of applicators and tubes made, and by an increase of 140 in the patients' attendances.

During the past twelve months, Drs. Powell White and Harris, of the Cancer Research Laboratory of the University, have prepared and reported on twenty sections of the various growths and morbid tissues submitted to them for microscopic examination. A large number of other growths have been examined at the clinical laboratories of the various hospitals participating in the scheme.

Sixteen military patients have been treated for various diseases during the past year.

TABLE I.

In this table a list is given of all the cases of malignant disease, with the exception of rodent ulcers, which were well on December 31st, 1916. It states also the period during which patients were free from symptoms or signs. The following notes are necessary in explanation:—

(*a*) *Carcinoma of the Bladder.*—One patient was reported last year as being free from symptoms, but a return of hæmaturia nine months later necessitated a second application of radium. He has now been well for four months.

(*b*) *Carcinoma of the Breast*—No cases were reported as being well last year, so that in no instance has a patient been apparently free of the disease for more than twelve months.

(*c*) *Carcinoma of the Cervix of the Uterus.*—Two of the cases reported well last year have had a recurrence of disease.

(*d*) *Carcinoma of the Larynx.*—The case of carcinoma of the larynx reported well last year has recurred.

(*e*) *Carcinoma of the Tonsil.*—One case was reported last year as being apparently cured. It appears to have been an error of diagnosis. It was probably a case of lympho-sarcoma, and as such has since manifested itself.

(*f*) *Carcinoma of the Skin.*—All these cases have remained quite well.

(*g*) *Sarcoma Muscle.*—One case reported last year as being well has recurred.

(*h*) *Sarcoma Naso-pharynx.*—Owing to lack of information it was impossible to publish information on one of these cases in last year's report. Recently this case has been seen again, and is apparently well.

The notes above show that five cases indicated in the table last year as being well at the end of that time have, after varying periods of immunity, relapsed, whilst one which recurred but was re-treated is free from symptoms and signs again. Thus, of the seventeen cases reported as being apparently free of the disease at the end of 1915, twelve still remain well. Of course, all the cases of malignant disease reported in the following list were regarded as inoperable by the surgeon.

TABLE I.

Disease.	Sex.	Age.	Period of apparent freedom from disease.
CARCINOMA.			
Carcinoma bladder	M.	55	4 months
,, ,,	M.	63	8 ,,
,, ,,	M.	48	4 ,,
Carcinoma breast	F.	43	6 ,,
,, ,,	F.	47	2 ,,
,, ,,	F.	51	3 ,,
,, ,,	F.	50	4 ,,
,, ,,	F.	81	12 ,,
,, ,,	F.	50	6 ,,
,, ,,	F.	42	4 ,,
,, ,,	F.	72	1 ,,
Carcinoma cervix uteri	F.	60	1 ,,
,, ,, ,,	F.	59	6 ,,
,, ,, ,,	F.	62	19 ,,
,, ,, ,,	F.	47	14 ,,
,, ,, ,,	F.	58	6 ,,
Carcinoma colon	F.	39	18 ,,
Carcinoma ear	F.	66	6 ,,
Carcinoma lip	F.	60	10 ,,
Carcinoma mouth	M.	63	4 ,,
,, ,,	M.	50	7 ,,
Carcinoma ovary	F.	51	18 ,,
Carcinoma parotid	M.	49	4 ,,
Carcinoma skin	M.	51	3 ,,
,, ,,	M.	58	9 ,,
,, ,,	M.	78	13 ,,
,, ,,	M.	60	4 ,,
,, ,,	M.	73	3 ,,
,, ,,	M.	43	6 ,,
,, ,,	M.	71	13 ,,
,, ,,	M.	47	16 ,,
,, ,,	M.	64	7 ,,
,, ,,	F.	65	5 ,,
,, ,,	M.	38	14 ,,
,, ,,	M.	78	3 ,,
,, ,,	M.	60	5 ,,
Carcinoma tongue	M.	62	5 ,,
,, ,,	F.	60	10 ,,
,, ,,	F.	65	14 ,,
Carcinoma tonsil	M.	54	6 ,,
Carcinoma thyroid	F.	47	21 ,,
SARCOMA.			
Sarcoma naso-pharynx	M.	10	19 months
,, ,,	M.	17	15 ,,
,, muscle	M.	52	3 ,,
,, tibia	M.	18	8 ,,
ENDOTHELIOMA.			
Endothelioma parotid	M.	46	7 months

A Series of Cases illustrating Interesting Points in relationship to Radium Treatment.

CARCINOMA OF THE BLADDER.

These cases have been treated chiefly through supra-pubic openings, which surgeons had made for the purposes of their own investigations. In the more localised cases it has been possible sometimes to bury a tube in the growth at the time of operation, otherwise a general irradiation has been given by passing a tube down through the supra-pubic opening. Radium has also been applied as a prophylactic by burying a tube or tubes at the site of the excision of a growth. Multiple papillomata of the bladder have been treated in the same way.

Example 1.—Male, aged 55.—This patient suffered on and off for five years with hæmaturia, pain, and difficulty on micturition. Two years ago a growth was removed surgically from the bladder. He was then well for the subsequent eight months, when some hæmorrhage returned. In February, 1914, a supra-pubic cystotomy was performed again, and a growth was found to occupy practically the whole of the inner wall of the bladder, and was quite inoperable. Thirty millicuries of radium emanation were passed down the supra-pubic opening into the bladder in a screen of 1 mm. of silver, and left in position for fifteen hours. The patient remained well for eight months when slight hæmaturia appeared again. Cystoscopic examination showed one small node of growth. Treatment was then given to the bladder per urethram for twelve hours, and the patient has been quite well ever since.

Example 2.—Male, aged 48.—This patient had a three years history of pain and hæmaturia. In January, 1914, a small papilloma was removed from the region of the right ureteric orifice. In February, 1916, an indurating growth was in part removed surgically. A tube was buried at the site of the removal. A few days later a general irradiation of the bladder was given for twenty-four hours. He has been in perfect health ever since.

Carcinoma of the Breast.

In this instance the best results follow the implantation of an adequate number of emanation tubes in the growth and along the course of the lymphatic vessels. In some cases as many as twelve tubes have been buried at one time. If the tumour be very firmly fixed to the chest wall the results are not so good, and treatment by implantation must be employed with extreme caution or the breaking down of the growth may produce an intractable ulcer. Often it is better not to bury at all under these circumstances, but simply to apply plates externally. It is always necessary to convince oneself that the situation and size of the growth give adequate opportunities for local repair. If the growth of the breast be too large, it is best to remove it locally and to apply radium at the site of removal, and along the lymphatic tract. Radium is also most useful in assisting surgeons to operate in borderline cases, or for the treatment of inoperable glands of the neck. Small scattered glands of the neck may be treated by the application of plates or larger masses by the method of burying. In the latter instance the results are often most gratifying. Small secondary skin nodules often disappear when treated by superficial plates, but their widespread nature inclines one to think that it is likely that X-ray treatment would be the best method of dealing with them in the future.

It is by no means always necessary to produce a severe local reaction in order to remove a malignant growth by radium. It is often done without the patient's knowledge that anything is happening at all; and increase of knowledge will no doubt practically eliminate the occurrence of a reaction which is a source of discomfort to the patient.

Example 1.—Female, aged 72.—This patient had a two years history of a swelling of the right breast with the formation of a lump in the right axilla. She had only slight symptoms of discomfort. Her surgeon deemed her growth to be inoperable.

In the upper and outer quadrant of the right breast was a hard mass, the size of a hen's egg. It was adherent to the skin, but could be moved somewhat on the chest wall. In the right axilla was a mass of six or more hard glands adherent to one another. Slight movement of them in the deep tissues was possible.

Five radium emanation tubes (each of 20 mc. strength, and contained in screens of platinum $\frac{3}{10}$ mm. thick) were buried in the breast (three) and axilla (two) for twenty-four hours. The growth diminished much, and treatment was repeated two months later with four tubes. Three months later some indefinite thickening remained in the right breast, one gland could be felt in the right axilla, and one small supra-clavicular gland had appeared. Treatment was continued by the external application of radium plates, screened by 1.5 mm. of lead, for twenty-four hours. This was repeated six weeks later, and seven months after the first application of radium all signs of the growth had disappeared.

The above is an example which shows how much perseverance is sometimes necessary. Other cases have cleared up more quickly, and it has not been necessary to apply plates.

Example 2.—Female, aged 50.—In 1913 radical amputation of this patient's right breast was performed for carcinoma. Twelve months later a nodule appeared at the inner end of the scar. The nodule gradually grew, and eventually broke down and ulcerated. When she presented herself with a view to radium treatment, she had at the sternal end of the breast scar an elliptical ulcer 3 by 2 cm. It was surrounded by a zone of infiltration measuring 1 cm. across, and its edges were thickened, hard, and undermined. The whole ulcer was intimately united with, and fixed to, the chest wall. In the neck above the inner end of the clavicle was a hard rounded gland the size of a hazel nut. It was not firmly fixed. No enlarged glands could be felt elsewhere. Looking to the nature and situation of the ulcer it was decided that treatment by external plates was the only method available. The patient received nine applications of plates of a strength of 2.5 mg. of radium to the square centimetre, screened by 2 mm. of lead, for twenty-five hours, both to gland and ulcer, an interval of six weeks elapsing between each application. At the end of that period both the gland and the ulcer had disappeared, leaving no sign of the growth.

The above example shows that occasionally a good result may be obtained in an apparently unpromising case by the use of plates alone.

Carcinoma of the Cervix of the Uterus.

Cases of carcinoma of the cervix of the uterus in which the vaginal wall is extensively involved are in most cases best left alone. Short of this, however, a large proportion of cases can be given six to twelve months immunity from symptoms, together with remarkable improvement in general health. The tendency is to give increasingly larger doses, employing six or seven or more tubes or needles. Under these conditions it is likely to become the rule rather than the exception to remove the cervical growth altogether.

Example 1.—Female, aged 42.—This patient had a two years' history of loss of weight and a vaginal discharge. For three months the discharge had been bloody, and she had suffered from pain in the lower abdomen and back. She had four treatments of twenty-four hours each with tubes, the wall of which was 1 mm. of silver or $\frac{3}{10}$mm. platinum thick, and containing from 36 to 80 mc. of emanation. There was slight improvement on each occasion. Subsequently 140 mc. of emanation were introduced into the cervix in six tubes at one time for twenty-four hours. Five weeks later all ulceration, pain and discharge had gone, and only a small area of induration remained in the left side. This example shows well the value of large doses.

Example 2.—Female, aged 59.—In this case the patient had been suffering from abdominal pain and a bloody vaginal discharge for five months. She had a large friable growth of the posterior lip of the cervix extending also well up the cervical canal. The uterus was tethered to the left side by induration running into the left broad ligament. Two small treatments produced slight improvment, a third much larger one cleared away all signs of the growth, and the patient has remained quite well since.

Carcinoma of the Colon.

It is not usual in these cases to get any very marked improvement from the application of radium plates to the abdomen over the site of a growth, nor is it common on laparotomy to find one in which it is possible to implant radium emanation tubes. Occasionally, however, it has been found practicable to do so.

Example 1.—Female, aged 39.—This patient suffered for nine months from abdominal pain and constipation. She was admitted to the Manchester Royal Infirmary with chronic intestinal obstruction, which was relieved by enemata. When this had been done a large hard fixed tumour could be felt on palpation in the left iliac fossa. Laparotomy was subsequently performed, and a mass, the size of a tangerine orange, was found growing from the outer wall of the descending colon at the region where it joins the sigmoid flexure. The mass was adherent to the abdominal wall. Two tubes were buried in the growth. Within a short period all the pain had gone, the constipation could be controlled by medicine, and the palpable tumour was about half its original size. After five months the treatment was repeated, and a few months later the patient returned with abdominal pain and constipation. On opening the abdomen it was found that the site of the growth was occupied only by a band of fibrous thickening, and the surgeon was of the opinion that the symptoms were entirely due to the constriction. Some radium was buried as a precaution, with instructions that the patient was to return later for lateral anastomosis to be performed.

Example 2.—Female, aged 45.—This patient had been suffering for over twelve months from persistent vomiting, constipation, and pain. Laparotomy was performed in January, 1915, but the growth was found to be quite inoperable, so nothing further was attempted. In February, 1916, a large mass could be felt in the right hypochondrium, and it was decided again to explore the abdomen with a view to radium treatment. On this occasion a large carcinoma of the hepatic flexure of the colon was found. It was adherent to the abdominal wall, but the stomach did not appear to be involved. No growth was found in the liver, but there were a few enlarged glands in the mesentery. Three tubes of radium, each of a strength of 20 mc. and screened by $\frac{3}{10}$ mm. of platinum were buried in the growth and glands for twenty-four hours. Up till the end of June the patient gained in weight, ceased vomiting, and suffered much less pain. It was decided to re-open the abdomen and implant more radium. At the operation the malignant mass was found to be much smaller and more movable. Three tubes were inserted in the growth, and one in the mesenteric glands, all for twenty-four hours. In December, 1916, only slight thickening could be felt in the region of the growth, and the patient was completely free of symptoms.

Carcinoma of the Mouth and Tongue.

The treatment of neoplasms of the mouth and tongue by radium does not appear to be making much progress at present. Those cases in which a satisfactory result has been obtained have either been large ulcers right at the back of the tongue, or small growths which were inoperable merely as a result of their position.

Example 1.—Female, aged 60.—This patient had a history of soreness of the throat for a year, and for some months her voice had been hoarse. At the back of the tongue, not directly visible from the mouth, was an ulcer occupying the left two-thirds of the posterior part of the tongue and measuring about 3 cm. arcoss. It was deeply indurated beneath, and the thickening extended across the whole breadth of the tongue. Under the left angle of the jaw were two large hard glands, each the size of a marble. A radium emanation tube of the strength of 18 mc., contained in a cylinder of silver the wall of which was 1 cm. thick, was inserted into the floor of the ulcer. Six weeks later the ulcer had healed over completely, but some induration remained. Twice subsequently tubes were buried in the ulcer and the glands. For the last ten months the patient has been quite free from any sign of the disease.

Example 2.—Male, aged 63.—The patient had a history of pain in the right side of the throat for three years. When he came for examination there was an indurated growth covering the right anterior pillar of the fauces, spreading downwards and involving a small portion of the tongue. No glands were palpable. Four emanation needles of Stevenson & Joly's type, each of the strength of 4 mc. and screened by $\frac{3}{10}$ mm. of steel, were inserted into the growth for twelve hours. Two months later the growth had disappeared except for two small nodules, one at the top and one at the bottom of the site of the original lesion. Three more needles were buried again for twelve hours, and six weeks later no sign of the growth remained. The patient was still quite well at the end of December, 1916.

Carcinoma of the Rectum.

If the growth be not too near the anal margin, it is worth while giving the patient two or three applications of radium; but although the immediate relief may be very great, as a rule the patient eventually relapses and the treatment is of no further avail. One case which had been treated three times was seen subsequently by the surgeon, who thought the growth had become operable, but unfortunately the patient did not submit himself to operation. An attempt has been made to bury tubes in one or two cases, but the results have not been very satisfactory.

Example 1.—Female, aged 52.—This patient had a three years history of tenesmus and pain in the lower part of the back. She also suffered from rectal hæmorrhage. About 8 cm. up the rectum could be felt the lower end of a hard ulcerated annular growth, which appeared to be almost completely fixed. Anteriorly deep induration reached forward to the vagina, to which the mass was adherent. The induration also extended considerably on the left-hand side. She was treated by inserting in the lumen of the growth a tube of 25 mg. of radium in a screen of 2 mm. of lead. It was applied for twenty-four hours in all. Six weeks later the growth was a trifle smaller, and the patient suffered no longer from pain or bleeding. She slept well, ate well, and was able to resume work. She felt better than she had done for two years. Similar treatment was given subsequently, and the patient put on ten pounds in weight, keeping in good health for eight months, then her symptoms gradually returned, and her general health became worse in spite of further treatment.

Carcinoma of the Skin.

Carcinoma of the skin in its earlier stages can be treated in a manner very similar to rodent ulcers. The disease when it comes to the Radium Institute, however, is usually much further advanced. Commonly there is a large deep ulcer with much induration beneath and a heaped-up and hard surrounding edge. There are frequently secondary glands. The growth is, of course, in some instances too extensive to hope for much benefit from radium treatment. Very frequently, however, brilliant results are obtained. It is necessary in the more advanced cases to bury tubes of radium emanation in the edges of the ulcer, and often in its base. Stevenson & Joly's needles are also of great value in the treatment of this condition. They can be inserted into the ulcer for periods of six to twelve hours without the use of a general anæsthetic.

Example 1.—Male, aged 60.—This patient had been suffering for three months with a swelling behind his left ear. For about six weeks it had become ulcerated, and had grown steadily in size. The ulcer, when the patient came to be seen, was 2.5 cm. in diameter, and was considerably raised above the surrounding skin. There was much induration around and beneath it, and its base was firmly adherent to bone. A doubtful gland was present in the left side of the neck. Treatment by radium plates had little effect, and subsequently four emanation tubes, the four together containing 40 mc. of radium emanation (screened by $\frac{3}{10}$ mm. of platinum) were buried in the growth, and left in position for twenty-four hours. At the end of six weeks, except for a small nodule, the site of the ulcer was marked only by a healthy scar, but a mass of glands had appeared in the neck. One more tube was buried in the ulcer, and three in the glands of the neck. The remains of the ulcer and the glands of the neck yielded rapidly to the treatment, and the patient has now been quite well for seven months.

Example 2.—Male, aged 47.—The lesion had been in existence for twelve months. At first it looked like a small scratch on the right-hand side of the nose. Subsequently it developed into a nodule, and grew rapidly larger. When first seen it measured 2 by 1 cm., and on it was a small scabbed area. As the diagnosis was doubtful a piece was removed for section before treatment was given, and, microscopically, it proved to be a squamous celled carcinoma. Two treatments of five hours each were given with Stevenson & Joly's needles, and the small indurated edge which subsequently remained was radiated for twenty-five hours by means of a radium plate screened by 1.5 mm. of lead. The growth disappeared rapidly, leaving very little deformity of the nose, and the patient has now been well for sixteen months.

Carcinoma Vulvæ.

These cases as a rule have proved very refractory to radium treatment. Attempts have been made to radiate them by plates, or the implantation of tubes. Little good usually resulted from the treatment. Two cases, however, have been recently treated by means of Stevenson & Joly's needles with considerable benefit. The drawback, however, has been the rather severe and painful reaction. One of the two cases is quoted below.

Example 1.—Female, aged 57.—This patient was suffering for four years from pain on micturition and blood-stained discharge. Shortly before coming to the Radium Institute the pain had much increased and was constant, and the patient's general health was much impaired. When first seen she had a large fungating growth surrounding the posterior and left aspects of the urethra, spreading on to the left labium majus, reaching also to the right labium, and on the left-hand side extending back on the left aspect of the vaginal orifice. There was considerable induration, which was particularly marked just behind the urethra. No enlarged glands were palpable in the groins. The growth was treated four times during the course of twelve months by means of needles. On the first occasion two were employed, and at each subsequent application six were used. The time of exposure was twelve hours in each instance. The growth steadily improved from the beginning, the pain and discharge gradually stopped, and when last seen in December, 1916, all that remained was a small button of induration lying behind, and to the left of the urethral orifice. The patient, who had previously been a chronic invalid, was doing her work as usual, and had gained many pounds in weight.

SARCOMA ABDOMINAL MUSCLE.

The three cases hereunder noted are all interesting from the point of view of diagnosis and radium treatment. The first case is one of true sarcoma of the left rectus, the other two are examples of fibrosis of the abdominal muscles and chronic intestinal myositis respectively. The case of sarcoma yielded very slowly to radium treatment, while the other two cleared up extremely rapidly.

Example 1.—Female, aged 29.—In September, 1915, this patient came to the Manchester Royal Infirmary for treatment of a hard growth, about 15 cm. long and 7 cm wide, in the upper part of the left rectus abdominis. The surgeon made an exploratory incision, and a piece of the growth was removed for microscopic examination; it proved to be a myxo-fibro-sarcoma. On one occasion three tubes of radium emanation, each of a strength of 20 mc. and screened by 1 mm. of silver, were inserted into the growth for twenty-four hours. A considerable reduction in the size of the tumour resulted. It was then decided to continue the treatment entirely by means of heavily-screened radium plates applied externally for periods of twenty-five hours. The patient has had nine such treatments, and the growth has slowly decreased in size until at present all that can be palpated is a small elongated patch of thickening. The treatment has thus been continued over a period of fourteen months.

Example 2.—Male, aged 42.—This patient was operated on by a surgeon with a view to removing the tumour of the abdominal wall, occupying practically the whole of the abdominal muscle to the right of the middle line, and from the level of the umbilicus downwards. At the time a piece of the growth only was removed for section, but no further operation was performed. The section under the microscope showed extensive fibrosis of muscle, which suggested syphilis, but the Wassermann reaction was negative. Two emanation plates, each containing 28 mc. of radium emanation and screened by 1.5 mm. of lead, were applied to the growth for twenty-four hours. Two months later no thickening whatever remained, and no recurrence of the growth has taken place, although twenty-one months have elapsed since the treatment was applied.

Example 3.—Male, aged 40.—This patient came to the Royal Infirmary in January, 1915. He had then five weeks history of swelling of the left thigh and pain down the front of the thigh and leg. A fixed growth could be felt in front of the upper part of the left femur. It was hard, elliptical in shape, and about 15 cm. long. An exploratory incision was made over the tumour, and three emanation tubes containing 80 mc. of emanation were buried in it. A piece was removed for microscopic examination. The section showed the case to be one of chronic interstitial myositis. The growth rapidly became smaller, and the patient has now been free of signs and symptoms for nearly two years.

UTERINE HÆMORRHAGE.

Five cases of uterine hæmorrhage of obscure origin have been treated by radium during the past two years. Drs. Kelly and Burnam, of Baltimore, have published a paper containing a series of cases of uterine hæmorrhage, which they have treated by means of radium with most satisfactory results. They often employed extremely large doses, and frequently a very pronounced general reaction resulted. In these five, however, it has not been customary to use more than 50 mc. of radium emanation, contained in a silver tube, the wall of which was 1 mm. thick. The tubes were inserted into the cavity of the uterus, and retained there for twenty-four hours, in one case for forty-eight hours. No noticeable reaction followed. One case failed to respond at all to the treatment, and received only one application. The other cases have remained quite well after one dose, with the exception of one which had two.

EXOPHTHALMIC GOITRE.

A number of cases of exophthalmic goitre have improved a great deal from the application of radium, but it is felt to be too early to make any extended observations on the results obtained.

RODENT ULCER.

Of the cases reported well last year, two have recurred, but are under control by treatment again. All the other "apparently cured" cases are still well, and there have been some very satisfactory results in several advanced cases. Stevenson & Jolys' needles have been very useful in the advanced cases.

CLASSIFIED RESULTS.—TABLE II.

Free of disease at the end of the year...	105
Improved	317
Not improved	216
Abandoned treatment	91
Died from their disease	90
Too early to note result	34
Prophylaxis	20
Not treated	127
Total	1,000
The number of new cases registered during the year was	502

TABLE III.

Classification of Cases.

Disease.	Too early to note result.	Not improved.	Improved.	Free of disease at end of year.	Died from their disease.	Abandoned treatment.	Total.
CARCINOMA:							
Antrum	—	1	—	—	—	—	1
Anus	—	—	1	—	1	—	2
Bladder	—	—	1	3	1	2	7
Breast	9	38	55	8	18	12	140
Cervix of uterus	1	16	37	5	5	8	72
Colon	—	3	1	1	1	—	6
Ear	—	—	—	1	—	—	1
Glands	—	5	2	—	2	1	10
Jaw (upper)	1	—	1	—	—	—	2
Jaw (lower)	1	3	2	—	—	—	6
Larynx	—	1	2	—	1	1	5
Lip	—	—	2	1	—	2	5
Mouth	3	23	28	2	9	4	69
Naso-pharynx	—	—	—	—	2	1	3
Nose	—	—	—	—	1	—	1
Œsophagus	—	1	—	—	5	1	7
Orbit	—	1	—	—	—	—	1
Ovary	—	2	1	1	—	3	7
Pancreas	—	—	—	—	1	—	1
Pharynx and mouth	—	1	—	—	—	—	1
Paget's disease	—	—	1	—	1	—	2
Parotid and sub-maxillary glands	—	4	4	1	1	1	1
Penis	—	1	1	—	—	—	12
Prostate	—	1	1	—	—	—	2
Perineum	—	1	—	—	—	—	1
Pylorus	—	—	—	—	—	1	1
Rectum	1	14	13	—	5	6	9
Scrotum	1	1	—	—	—	—	32
Skin (nose, face, etc.)	—	10	6	13	1	3	33
Spine	—	1	1	—	—	—	2
Stomach	—	1	2	—	1	1	5
Tongue	1	19	2	3	5	4	34
Tonsil	1	6	2	1	—	—	10
Thyroid	—	4	3	1	2	3	13
Urethra	—	—	1	—	—	—	1
Uterus	—	—	1	—	—	1	2
Umbilicus	—	1	—	—	—	—	1
Vulva and vagina	1	3	3	—	2	4	13
Prophylaxis	—	—	—	—	—	—	15
Total	20	162	174	41	65	59	536

Classified Table of Cases. Table III.—(*continued*).

Disease.	Too early to note result.	Not improved.	Improved.	Free of disease at end of year.	Died from their disease.	Abandoned treatment.	Total
Sarcomata:							
Bladder	—	—	—	—	1	—	1
Buttock	—	—	1	—	—	—	1
Glands	1	1	1	—	2	—	5
Jaw (upper)	—	—	1	—	—	—	2
Jaw (lower)	—	—	1	—	1	—	2
Kidney	—	—	—	—	1	—	1
Long bones	—	3	1	—	—	2	6
Muscle	—	1	4	1	—	1	7
Naso-pharynx	—	—	1	2	2	1	6
Orbit (bony)	—	—	—	—	—	1	1
Orbit	—	1	—	—	—	—	1
Palate	—	—	—	—	1	—	1
Pelvis	—	1	—	—	—	—	1
Periosteum	—	1	1	—	—	—	2
Popliteal space	—	—	1	—	—	—	1
Pleura	—	—	1	—	1	—	2
Parotid gland	—	—	1	—	—	—	1
Retro-peritoneal	—	—	1	—	1	1	3
Ribs	—	—	1	—	—	—	1
Supra-renal gland	—	—	—	—	1	—	1
Tibia	1	—	—	1	—	—	2
Testis	—	—	—	—	—	1	1
Tonsil	—	—	1	—	—	—	1
Prophylaxis	—	—	—	—	—	—	4
Total	2	8	18	4	11	7	54
Rodent Ulcer	—	18	30	46	2	5	101
Malignant Tumours (various):							
Endothelioma	1	1	4	1	2	—	9
Glands—malignant	—	4	7	—	3	3	17
Lung—malignant	—	—	1	—	—	—	1
Lymphosarcoma	—	3	3	—	3	—	9
Mediastinal tumour	—	—	2	—	2	—	4
Prophylaxis	—	—	—	—	—	—	1
Total	1	8	17	1	10	3	41
Benign Tumours:							
Certain tumours of doubtful nature	—	1	1	—	—	1	3
Circoid aneurysm	—	—	1	—	—	—	1
Capillary naevus	—	1	4	—	—	1	6
Cavernous naevus	—	—	4	—	—	—	4
Fibroma—Abdominal wall	—	—	1	—	—	—	1
,, Hand	—	—	—	—	—	1	1
,, Penis	—	—	1	—	—	—	1
,, Uterus	—	—	1	—	—	—	1
Glioma orbit	—	—	—	—	1	—	1
Kraurosis	—	1	1	—	—	—	2
Myxoma uterus	—	—	—	—	1	—	1
Myeloid sarcoma	—	2	1	1	—	1	5
Papilloma, bladder	—	1	1	—	—	—	2
,, hard palate	—	1	—	—	—	—	1
,, skin	—	—	1	1	—	1	3
,, vulva	—	—	1	—	—	—	1
Total	—	7	18	2	2	5	34

CLASSIFIED TABLE OF CASES. TABLE III.—(*continued*).

Disease.	Too early to note result.	Not improved.	Improved.	Free of disease at end of year.	Died from their disease.	Abandoned treatment.	Total.
GENERAL AND SKIN DISEASES, CHRONIC INFLAMMATION:							
Arthritis deformans	—	1	1	—	—	—	2
Diabetes	—	2	—	—	—	—	2
Excoriation of nipple	—	—	1	—	—	—	1
Exophthalmic goitre	11	3	21	—	—	5	40
Eczema (chronic)	—	—	1	—	—	—	1
Glossitis	—	—	—	—	—	1	1
Granuloma	—	—	—	1	—	—	1
Hodgkin's disease	—	1	8	—	—	2	11
Keloid and vicious cicatrix ...	—	—	10	3	—	2	15
Lymphatic leukæmia	—	1	1	—	—	—	2
Leukoplakia	—	—	1	—	—	—	1
Lymphangitis (chronic)	—	—	1	—	—	—	1
Lupus vulgaris	—	—	2	—	—	—	2
Lupus erythematosus	—	—	—	—	—	1	1
Mastitis (chronic)	—	1	—	—	—	—	1
Macroglossia	—	1	—	—	—	—	1
Mucous colitis	—	—	1	—	—	—	1
Myositis (chronic)	—	—	—	2	—	—	2
Oto-sclerosis	—	—	1	—	—	—	1
Pruritis	—	1	1	1	—	1	4
Psoriasis	—	—	1	—	—	—	1
Pigmented mole	—	—	2	—	—	—	2
Spring catarrh	—	—	2	—	—	—	2
Spleno medullary leukæmia ...	—	—	2	—	—	—	2
Sinus (chronic suppurating) ...	—	—	1	—	—	—	1
Tubercular glands	—	1	2	—	—	—	3
Uterine hæmorrhage	—	1	—	4	—	—	5
Total	11	13	60	11	—	12	107

TABLE IV.

Statement showing the Number of Patients Registered during the year ended 31*st December*, 1916.

The number of patients registered up to 31st December, 1916, was 502. 491 have been seen by the Radiologist, of whom 363 have received treatment, 126 have been found unsuitable, 11 have not attended after registration, and 2 have been placed on the Waiting List.

Name of Hospital.	Registrations.	Consultations.	Patients Treated.
Ancoats	9	8	3 at Ancoats 2 at M.R.I.
Bury	2	1	1 at M.R.I.
Christie	9	9	9 at Christie
Northern	20	19	12 at Northern 2 at M.R.I.
St. Mary's	13	13	11 at St. Mary's
Salford Royal	19	18	10 at Salford Royal 5 at M.R.I.
Stockport	—	—	—
Private and Special Patients ...	86	86	35 Outside 39 at M.R.I.
M. and S. Skin Hospital	12	11	10 at M.R.I.
M.R.I.	332	326	187 In-patients 37 Out-patients
Total	502	491	363

The total number of attendances during the year was 2,810. During the year 589 Inpatients were also treated. A number of patients from other Hospitals were treated at the Christie Hospital.

31*st December*, 1916.

NOTES AND ABSTRACTS.

RADIUMTHERAPY.

New York Medical Journal, December 18th, 1915.—In an article on the use of soluble radium salts in organic nervous diseases Dr. Alfred Gordon gives the results of some experiments he has made on dogs with the object of observing the effects of such salts when brought into actual contact with the central nervous system. He was led to try thesee experiments by noticing the amelioration which took place in various conditions of the peripheral nerves as the result of radium applications.

It is noted that the favourable results claimed by some operators from the use of intravenous injections of radium are not shared by all, and the following case is quoted as an example. A middle-aged woman had suffered for 18 months with pain in the limbs and tenderness on pressure over the nerve trunks, as the effects of multiple peripheral neuritis; she received an intravenous injection of a radium salt solution and also drank radium-containing water. Within 48 hours the pain ceased and she was able to walk a short distance, having previously been bedridden for several months. In spite of this apparent improvement a general spastic condition developed, characterised by rigidity of the trunk muscles on the slightest exertion. If she attempted to walk her muscles became so rigid that her head was pulled down between her shoulders and the dorsal muscles contracted to such an extent that she was arched backwards and her abdomen thrust forwards: this spasticity remained at the time of writing three months later without any tendency towards improvement.

In all, Gordon made four experiments on dogs with strict anæsthetic and antiseptic precautions. The method adopted in the first three cases was to expose the spinal membranes by means of laminectomy without opening them and then to compress the cord through the membranes. When the dogs had recovered from the effects of the anæsthetic they were found to have flaccid paralysis of the hind legs and tail, together with incontinence of urine and diminished pin-prick sensation. At a later period the radium was injected into the membranes.

The first dog died too soon after the injection for any changes in its condition to be observed.

In the second case the radium salt was injected just above the compressed area of the cord, and ten hours after the injection the following conditions were noticed. The paralysis of the hind legs and bladder remained unaltered but the front limbs became rigidly extended, though no sensory changes could be detected in them. During the next five days the condition of all four legs was unchanged, but increasing dyspnœa was evident, and it gradually became more marked until the dog died.

The radium injection in the third animal was made immediately below the compressed area, and the paralysis of the hind legs began to change from a flaccid to a spastic type twelve hours after. The spasticity increased and persistent erection of the penis was seen, though the sphincters remained in a state of flaccid paralysis. This condition persisted for eight days when the animal died suddenly. At no time were the front legs or respiration affected.

Gordon attributes the different incidence of the spasticity in these two cases to the fact that in the former one the injection was above the compressed area of the cord, and thus allowed the radium solution to reach the upper part of the central nervous system, at the same time hindering its flow downwards, whilst in the latter case the injection was below the constriction and could operate on the lower portion of the cord without having access to the upper section.

In the fourth animal the procedure was varied by omitting the preliminary compression of the cord and simply injecting the solution into the normal spinal canal. Four hours after the introduction of radium the hind legs were markedly rigid and extended, though sensation and sphincters were unaltered. This condition remained during the following four weeks and then slight flexion was noticed on a few occasions. With the exception of the spastic condition the dog was still in normal health at the time of writing.

Gordon considers that the radium was undoubtedly the causative agent in producing the spastic condition, and remarks that caution should be exercised in using radium salts in organic diseases of the nervous system. The absence of sensory changes shows the effect to be through the motor neuron, and the spasticity proves it to be of an irritative nature.

H. M. B.

New York Medical Journal, July 8th, 1916.—Dr. W. H. B. Aikins discusses the etiology and treatment of exophthalmic goitre, and records several cases in which he has derived great benefit from local applications of radium to the thyroid gland. He lays stress on the point that the irradiation must be regarded as only a part of a systematic course of treatment, and that attention must be given to the general state of the patient, with particular regard to the nervous system.

The glandular and neurogenic theories are noted, and the importance of thymic enlargement emphasised, also the co-existence of constitutional diseases. From a study of reports he draws the conclusion that the percentage of recoveries is about the same under surgical and non-surgical treatment, but it is pointed out that for some cases surgery is imperative, and that each one must be judged on its own merits. Whatever the treatment adopted it is unusual for all the symptoms to disappear completely, and we are justified in speaking of cure if the general health is maintained and the patient is able to resume his ordinary occupation.

In any variety of treatment it is essential to reduce the vascularity of the thyroid gland—hence the benefit often obtained from simple rest treatment in the slighter cases. The necessity for a liberal and easily digested diet is indicated, though food rich in extractives must be avoided. Many drugs have been recommended, and Aikins finds the most useful to be capsules containing five grains of quinine hydrobromide with one grain of ergotin.

Brief mention is made of treatment by X rays and references given to the opinions of several workers in this field.

The first man to use radium successfully was Abbe: the experiments of Victor Horsley and Finzi show that the most constant effects of radium are on the blood and lymph vessels, and the author's own experience is that the vascularity and secretion of the gland are both diminished. Dawson Turner considers that radium has advantages over X rays in the control of dosage and in the ability to apply the treatment whilst the patient remains in bed at home.

Seven cases of radium treatment are cited, all in females, with ages ranging from 19 to 45, and with a favourable result each time.

CASE 1.—Thyroid enlargement noted five years previously with rapid increase during the last month. Dyspnœa, dysphagia, poor appetite, nervousness, and weakness were complained of. Examination showed the thyroid enlarged and pulsating: pulse 88, and increased on the slightest exertion: circumference of neck 15 inches. Thyroidectin tablets were ordered and an irradiation of 100 milligram hours administered. One week later the neck measurement was 14 inches, pressure symptoms relieved, and she felt better; in five weeks the measurement was 13 inches, swelling had almost disappeared and the patient felt, and remained, quite well.

CASE 2.—Patient had been so nervous and excitable for a year that her parents feared for her mental condition. She had marked tremor, rapid heart and enlargement of the thyroid with a neck measurement of 14 inches. The treatment adopted was rest, ice-bag over the heart, quinine capsules, and the thyroid was subjected to "heavy exposure to radium rays." Three months later the neck was 12½ inches, and the tachycardia and nervous symptoms had disappeared. Further radium treatment was given, after which the patient resumed her normal life and has remained well for two years.

CASE 3.—When first seen the neck measured 16¾ inches, there was no tachycardia, and tremor was only slight. Absolute rest was not insisted on until the pulse rate suddenly shot up to 160. "Radium was applied" to the thyroid and in three months the neck measured 12½ inches and the pulse rate became normal. She has remained well for over three years.

CASE 4.—History of five months duration of exophthalmic goitre developing six months after removal of the ovaries. The gland was only slightly enlarged, but there was marked tremor and a pulse of 140. She had been treated by rest, diet and medicaments, with no avail. "Heavy radiation" of the thyroid was instituted and the improvement was "marvellous." Within two weeks the pulse dropped to 75 and the nervousness almost disappeared. She was kept under observation for six weeks and was then apparently in normal health, which state continued.

Case 5.—Prominent thyroid: neck measurement 14½ inches: exophthalmos: pulse 120: great nervousness: no benefit from general medical treatment. An exposure of 70 milligram hours was given over the thyroid, the patient went home and was not seen again for five weeks when the neck measured 13½ inches but the pulse was still 120. Further irradiation was given and two months later the pulse was 76, tremor had disappeared and exophthalmos was hardly noticeable. Some time later the patient was again seen and the improvement was maintained; she was then able to do light house work.

Case 6.—In March patient became nervous, with marked tremor and a pulse of 130. Rest cure was followed by improvement but the slightest exertion caused a return of the symptoms. In October there was definite exophthalmos and the neck measured 14½ inches. The thyroid was irradiated by radium and the patient returned home. In November she both looked and felt better, the neck had decreased to 14 inches, pulse was 90 and the nervousness gone. Further radiation was given and by January the pulse was 76. The left lobe of the thyroid was still rather prominent but all symptoms of hyperthyroidism had disappeared.

Case 7.—Following influenza in spring, 1913, the patient had exophthalmos, dyspnœa and palpitation. These symptoms disappeared during the following winter but returned after tonsillitis in March, 1915, together with vomiting and a rapid pulse. From June she was kept in bed for five months and the pulse became normal. In August there was exophthalmos without thyroid enlargement but with a pulse ranging from 84 to 120. Radium was applied, and the patient improved to such a degree that in the following January she could take short walks or do light housework without disturbing the pulse, and the nervousness had practically gone. H. M. B.

New York Medical Journal, July 1st, 1916. —Dr. Joseph Bissell contributes two cases of bone sarcoma treated by radium.

Case 1.—Male, aged 19. Noticed a swelling of the thigh two years previously, and had been treated by X rays and Coley's fluid. Two separate pathological reports concurred in the diagnosis of spindle-celled periosteal sarcoma. Radiograph showed involvement of the whole circumference of the bone in its middle third, and had all the characteristics of sarcoma. Another plate, taken after the conclusion of the treatment, exhibited an appearance resembling that of chronic periostitis. During the course of treatment a severe radium burn developed and extended almost completely round the leg.

At the beginning of treatment the circumference of the affected thigh was 53¼ centimetres at its largest point, while the corresponding measurement of the other limb was 35 centimetres. At the end of the course the diameter was reduced to 40¼ centimetres, and would have been even less but for the swelling of the soft parts accompanying the burn. The average amount of radium used was 400 milligrams, and the first few exposures were 24 hours each. Various kinds of filters were used—from three to five millimetres of rubber, together with two millimetres of brass or lead—and a space of 1½ inches was left between the skin and the screens.

Case 2.—Male, aged 5. Swelling of upper third of humerus noticed a year ago. Radiograph showed swelling and rarefaction of the bone. Diagnosis of periosteal sarcoma was made and was confirmed by pathological examination.

The measurements of the arm before commencing the treatment were: over the greatest circumference 22 cm., at the lower part of the tumour 17 cm., one inch above the maximum point 18 cm. Five applicators, each containing ten milligrams of radium, were bound round the arm and left in position for two hours, with a filter of three millimetres of lead covered by half a millimetre of rubber. This dose was repeated in a week and again two weeks later.

Measurements taken two months after the commencement of treatment were: maximum 18 cm., below 15 cm., above 16 cm. Two months later two similar doses were administered with a fortnight's interval between them, and the tumour almost disappeared; the child's general health was also very good.

After a further two months the tumour began to grow again and the general health became affected. A radiograph taken at this time showed what were thought to be metastases in the mediastinum. A section of the tumour was made and reported to be spindle-celled sarcoma; 150 milligrams of radium were applied to the arm. Several weeks later another radiograph was taken, and exhibited no evidence of metastases. Further radium applications have been made, each of twelve to fourteen hours, with 150 milligrams, but the tumour is still rather marked, though the general health is now normal.

Bissell has selected these two cases for the sake of the contrast they afford. In the first case the patient appears to have recovered entirely, and in the second improvement is only slight, yet the pathological conditions and treatment were similar. H. M. B.

RADIO-TECHNIQUE.

The X-ray in Industry.—*(American Journal of Roentgenology*, October, 1916. Reprinted from the *Edison Monthly*, May, 1916.)—One expedient resorted to in shipping rubber across the Atlantic was to pack it in bales of cotton waste. The scheme seemed destined for success until certain bales were selected for X-ray examination. Under the penetrating ray a faint shadow was cast on the fluoroscope. The bales were opened, and packed in every 350 pounds of cotton waste were found 250 pounds of rubber. In another instance the X-ray examination of the personal baggage of a traveller disclosed the presence of mine cases and asphyxiating bombs.

Recently a steel casting was received at the works of the General Electric Company, at Schenectady. It was $2\frac{1}{2}$ inches thick and weighed about one ton. During the process of machining down to the desired thickness slight imperfections were disclosed. It was then decided to make an X-ray examination of the entire casting. The steel was set on edge, backed by a sheet of lead with a photographic plate between. A Coolidge tube, designed especially to carry high voltages, was used. A current of 1·25 ma. was passed through the tube for each of several two-minute exposures. The resulting pictures located a long flaw. To confirm this finding a disc was cut from the metal at a point indicated on the radiograph, and the hole was found just as indicated.

Ordinary copper castings are full of pores and blow-holes, which not only reduce the mechanical value of the metal but result in very low electrical conductivity. This, of course, is due to the oxidization of the metal. Boron suboxide, a by-product of the manufacture of boron, has the property of deoxidizing copper without combining with it, and is now generally used at all copper plants. In the test boronized copper and unboronized copper were examined side by side, the X-ray photographs being recorded on the same plate. The pores in the unboronized metal showed clearly while the treated metal showed a solid structure. The photographs were afterwards confirmed by planing down the surfaces of the two castings.

Another illustration of the value of X rays is seen in the examination of built-up sheets of mica, used for insulation in electric motors and generators. Foreign substances of varying thicknesses make the material useless for this purpose. The ordinary inspection consists of a visual examination and gauging with a micrometer, which, at its best, is a slow process. Under the X rays all defects may be seen at a glance. The sheets are only ·032 inch thick, yet a variation of ·005 is indicated plainly.

Another application of X rays is at a tobacco factory in Key West. The tobacco beetle larva, which lives on the leaf, is so small that it cannot be seen. If it is not destroyed, it develops and eats its way through the finished cigar. At this factory the cigars are made and then packed in boxes, no effort being made to destroy the larva until after the containers have been closed. Then the boxes are passed through the X rays, the exposure destroying all life without affecting the tobacco. R. W. A. S.

PUBLICATIONS RECEIVED.

Books.

A Manual of Practical X-Ray Work. Second Edition. By David Arthur, M.D., D.P.H., and John Muir, B.Sc., M.B., Ch.B., and B.Sc. (Pub. Health), Capt. R.A.M.C.(T.) (Heinemann.)

X-Rays Second Edition. By G. W. C. Kaye, M.A., D.Sc., Capt. R.E. (T.) (Longmans, Green & Co.)

Journals.

American Journal of Electrotherapeutics and Radiology, April, May, 1917.

American Journal of Roentgenology, April, 1917.

American Medicine, April, 1917.

Archives d'Electricité Médicale et de Physiotherapie, May, June, 1917.

Archives de Médecine et de Pharmacie Militaires, Feb., 1917.

Boston Medical and Surgical Journal, April 19th, May 10th, 17th, 24th, 1917.

Bulletin of the Johns Hopkins Hospital, May, June, 1917.

Cleveland Medical Journal, March, April, 1917.

Endocrinology, April, 1917.

Journals—*continued.*

Gaceta Médica Catalana, May 31st, 1917.

Good Health, May, 1917.

Hospitalstidende, Jan. to May, 1917.

Interstate Medical Journal, May, 1917.

Journal of Cutaneous Diseases, April, 1917.

Journal de Radiologie et d'Electrologie, March-April, 1917.

La Radiologia Medica, May-June, 1917.

Maryland Medical Journal, May, 1917.

Medical Journal of Australia, March 24th, 31st, April 7th, 14th, 21st, 28th, 1917.

Medical Times, May, 1917.

New York Medical Journal, May 12th, 19th, 26th, 1917.

New York State Journal of Medicine, May, 1917

New Zealand Medical Journal, April, 1917.

Norsk Magazin for Lægevidenskaben, May, 1917.

Pacific Medical Journal, May, 1917.

Policlinico, Il., May 1st, 15th, June 1st, 1917.

Quarterly Journal of Medicine, April, 1917.

Proceedings of the Royal Society of Medicine, May, 1917.

Southern Medical Journal, May, 1917.

Ugeskrift for Læger, April 26th, May 3rd, 10th, 17th, 24th, 31st, 1917.

NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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THE SUPPRESSION OF INVERSE CURRENT IN THE DISCHARGES FROM THE SECONDARY TERMINALS OF INDUCTION COILS (INCLUDING A NEW METHOD OF EXCITING AN X-RAY BULB, WITH SPECIAL REFERENCE TO THE COOLIDGE TUBE).

By J. A. Shorten, B.A., M.B. (Captain I.M.S.), X-Ray Specialist, Colaba War Hospital, Bombay.
Assisted by T. W. Barnard (Lieut. U.L.), Radiographer, Colaba War Hospital, Bombay.

Introduction.—The suppression of inverse current in the secondary circuits of induction coils has long occupied the attention of investigators, not only in the field of X-rays, but in the physics of induction coils in general. It is a well known fact that the secondary discharge of an induction coil consists of alternating currents. The polarity of the coil is reversed many times per second, corresponding to the making and breaking of the primary current. The induced current produced at the break of the primary current is usually called "direct current," that produced at the make "inverse current." The former is greater in amount, and its potential is about twice that of the latter. An X-ray bulb requires for its proper excitation a high potential unidirectional current applied to it in the right direction. Current applied to the bulb in the wrong direction not only has little effect in producing X rays, but is positively harmful in that it causes disintegration of the anticathode, rapidly hardening the tube and shortening its life. From these considerations it will be seen that inverse current is the bugbear of the X-ray specialist. Efforts must therefore be made to diminish it or suppress it entirely.

The most obvious way to avoid the undesirable effects of inverse current would be to use a type of apparatus which does not generate it. There are three main groups of apparatus in use for exciting X-ray bulbs, viz. :—

1. Influence machines.
2. Induction coils.
3. Step up transformers.

Of these, influence machines give an entirely unidirectional current, and have been largely used in France, Germany, and the States for the production of X rays. They are little used in the United Kingdom on account of climatic conditions, and for the same reason are entirely unsuited for use in the tropics. Even under favourable conditions they are unreliable and tricky to work.

As regards high potential step up transformers, such types of apparatus depend for unidirectional current on some rectifying device, such as valve tubes in the Gaiffe apparatus, and a synchronous arrangement in the Snook apparatus. They give little or no inverse current and are easily controlled. The chief objections to such machines would appear to be their high cost, excessive noise, and the attention which moving machinery requires. In damp climates, too, there may be difficulty on account of leakage inside the cabinet. Indeed, I have seen a Gaiffe machine completely out of action in the monsoon season owing to brush discharges and surface leakage inside the cabinet and across the marble top outside.

Induction Coils.—For the reasons detailed above induction coils are largely used in the United Kingdom, and almost exclusively used in India. All ordinary induction coils give rise to a certain amount of inverse current, depending on differences in design, as will afterwards be explained. Quite recently a new type of coil has been manufactured in which the inverse current is utilized. Whether this type of coil will be a success in practice time alone will prove. Meantime, the majority of coils in general use give rise to inverse current in a greater or lesser degree. The following pages deal with the problem in connection with such coils, and set forth a new method of dealing with inverse current as well as of exciting an X-ray bulb.

Suppression of Inverse Current.—Inverse current may be reduced to a minimum :—

A. By paying attention to certain points in coil design:—

1. Increasing the number of turns in the primary and thereby the self-induction of the coil.
2. By reducing the magnetic leakage between the primary and the secondary. This depends on the structure and size of the core.

B. By paying attention to the interrupter.

1. Inverse current is increased by irregular interruption. The break should therefore be kept in good order.
2. By using a low frequency of interruption and a low voltage in the primary.

C. By using a bulb of moderate hardness. Inverse current tends to increase with softening of the bulb.

If, however, intense discharges are required other means must be adopted. These, in the main, are of two kinds :—

1. Valve tubes and rectifying spark gaps.
2. Synchronous rotary rectifiers.

Valve Tubes and Rectifying Spark Gaps.—There are many types of valve tubes in use, but it would be outside the scope of this paper to discuss their relative efficiency or differences in structure. They all depend on the principle of interposing a greater resistance to the passage of current in one direction than in the other. Among their disadvantages are :—

1. The difficulty in keeping the vacuum constant.
2. In India, particularly, difficulties in insulation.
3. If the resistance of the valve tube is too high the available energy in the high tension circuit may be seriously diminished.

As regards spark gaps placed in series with the X-ray bulb, a point to plate spark gap acts as a fair rectifier; but it interposes a resistance which greatly diminishes the available energy. Kaye quotes an experiment in which there was a drop from 60,000 to 39,000 volts due to the interposition of a spark gap.

Rotary Rectifiers.—These consist essentially of a device rotating synchronously with the interrupter, and so arranged that the high tension circuit is broken as the inverse potential becomes effective and made at the moment the direct current is passing. Apart from difficulties in producing exact synchronism the author has not seen any of this type of apparatus which stands the test of the oscilloscope.

From the above general remarks it will be seen that the rectification of the high tension currents of induction coils is not in a satisfactory position. The large number of rectifying devices is sufficient proof of that. The special case of the Coolidge tube will be discussed afterwards.

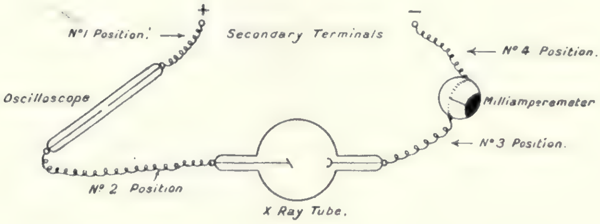
Experiments on Earthing the High Tension Circuit.

During the monsoon season of 1916 the writer was led by difficulties experienced in insulation, owing to the high percentage humidity of the atmosphere, to make some experiments in earthing different parts of the high tension circuit, with a view to ascertaining its effects on leakage in general.

The details of these experiments are as follows :—

Apparatus and Electric Supply :—

Primary Current : D.C. at 110 volts.
Interrupter : Watson's Dreadnought (mercury).
Coil : Watson's 16-inch intensified.



Plan of Arrangement of Apparatus.

No. 1 position: Earthing wire between positive pole of secondary and oscilloscope.
No. 2 position: Earthing wire between oscilloscope and positive terminal of tube.
No. 3 position: Earthing wire between negative pole of tube and milliamperemeter.
No. 4 position: Earthing wire between milliamperemeter and negative pole of coil.

First Series: September, 1916.

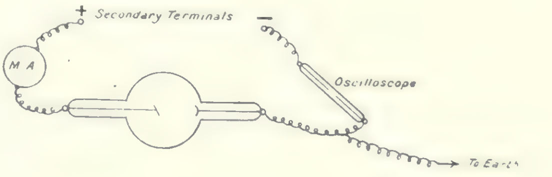
Characteristics of Tube Used:—Heavy anode; alternative spark gap, 3¼ inches; penetration, 4 Benoist.

During this series the position of the regulator in the primary was not altered. The resistance of the tube may also be taken to be constant as the experiments lasted only a very short time.

Position of earthing wire.	Primary current. Amperes.	Secondary current. Milliamperes.	Inverse current.
A. No. 1.	10	nil.	—
B. No. 2.	10	nil.	—
C. No. 3.	4·5	5 (nearly)	A little.
D. No. 4.	5	Over 5	A trace.
E. Unearthed.	5	Over 5	Considerable.

When these experiments were carried out the percentage humidity of the atmosphere was about 87 per cent. This probably accounts for the complete earthing of the direct current in A and B, as the return route to the coil *via* the damp table and air would be comparatively easy. In No. 3 position the inverse current passes through the milliamperemeter on its way to earth, so that the reading is less than in Nos. 4 or 5. The oscilloscope showed very little inverse current in the case of Nos. 3 and 4, but a considerable amount in the case of the unearthed circuit.

If the oscilloscope is placed between the negative pole of the tube and the negative pole of the coil, with the earthing wire in No. 3 position, it gives the appearance of a large amount of inverse current, as this current has to pass through the oscilloscope to reach the earthing wire.



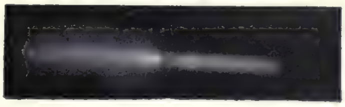
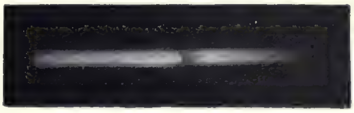
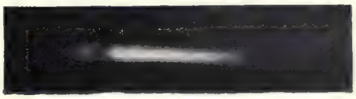
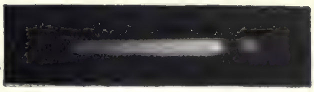
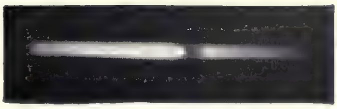
Second Series: September, 1916.

Tube Used:—Water cooled; alternative spark gap, 2 ins. penetration; 2 Benoist.

Position of earthing wire.	Primary current. Amperes.	Secondary current. Milliamperes.	Inverse current.
No. 1.	9	nil.	—
No. 2.	9	nil.	—
No. 3.	4·5	2	A trace.
No. 4.	4·5	2·2	A trace.
Unearthed.	3·	1·9	Considerable.

Third Series: February, 1917.—Atmospheric humidity, 69 per cent.

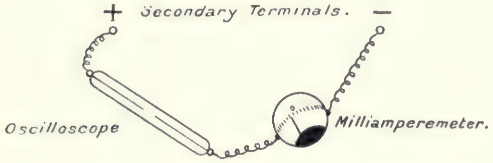
Tube Used:—Water cooled; alternative spark gap, 5 ins.; penetration 5 to 6 Benoist.

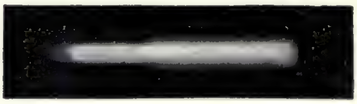
Position of earthing wire.	Primary current. Amperes.	Secondary current. Milliamperes.	Photograph of oscilloscope.
No. 1.	4	Needle swings 0 to 1·5 both ways.	—  +
No. 2.	4	Ditto.	—  +
No. 3.	4	1·2 (needle steady).	—  +
No. 4.	4	1·6 (needle steady).	—  +
Unearthed.	4	0·2 to 1·6 (needle unsteady).	—  + Much inverse.

In this series, owing to the comparative dryness of the atmosphere, a small proportion of the direct current passed through the tube in preference to completing the circuit by earth—in the case of 1 and 2. In No. 2 the oscilloscope shows all the direct and all the inverse current, as both currents have to pass through the oscilloscope.

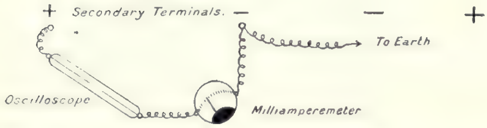
It is evident from the above results that earthing of the negative side of the high tension circuit diverts a large proportion of the inverse current to earth. This rectifying action is more noticeable with seasoned tubes. If the resistance of the tube is very low—below that corresponding to 1 inch alternative spark gap—the current, inverse and direct, takes the path of least resistance, viz., through the tube and high tension circuit. This fact is well shown by connecting up the poles of the coil through the oscilloscope and milliamperemeter. The arrangement of the apparatus and the results are as follows :—

A. (Unearthed).



Primary current.	**Secondary current.**		**Oscilloscope.**	
4 amps.	10 milliamps.	—		+

B. (Earthed).



Primary current.	**Secondary current.**		**Oscilloscope.**	
4 amps.	10 milliamps.	—		+

In this case the resistance in the high tension circuit is so small that neither current passes to earth. The practical inference to be drawn from this is that with new and very soft tubes some resistance must be introduced in the high tension circuit to effect rectification. In the absence of valve tubes a series spark gap or a water resistance will be found efficient. As soon as the tube is capable of backing up a spark gap of 2 inches such resistance may be dispensed with. In any case, a tube of such low resistance is useless for radiography, and the amount of inverse current which will pass with a small current will only tend to improve it.

When we come to consider why inverse current should pass to earth and not through the high tension circuit we meet with many theoretical difficulties. We know that the inverse current is less in amount and of lower potential—roughly, half the direct current. If, therefore, the X-ray bulb has sufficient resistance, or if we introduce a suitable resistance in series with the bulb, and earth the negative pole of the coil, we can understand that the inverse current will pass to earth if it is unable to overcome the resistance opposed to it in the high tension circuit ; but how does it reach the positive pole of the coil ? In the atmospheric conditions—percentage humidity from 80 to 98—in which the first experiments were carried out the greater part of the inverse current probably returned to the positive pole by surface creeping. The coil table, of unpolished teak, stood on a concrete floor and acted as a semi-conductor. Acting on this theory, the author was induced to place a metal grid on the coil table near the positive end of the coil and to connect this grid by a wire to the positive pole, thereby "earthing" the table to the positive pole of the coil and thus discharging any inverse current with which the former becomes charged. It was feared at first that there would be serious leakage of direct current, and the series of experiments described below, under unipolar excitation, were undertaken to settle this point. From these it will be seen that the use of the grid actually increases the milliampereage, a phenomenon which was also noted in connection with the Coolidge Tube. The author offers the following explanation: when a resistance is opposed to the passage of current in a high tension circuit the voltage of the current tends to rise—at the expense of milliampereage, of course, since the total amount of energy remains constant unless the current in the primary is altered. This applies to inverse current as well as to direct. The increased strength of the magnetic field thus created by the inverse current must militate against the rise of direct potential, and accounts for the unsteadiness of the milliamperemeter observed when a long series spark gap or a hard valve tube is used. If now we offer an alternative path, *viâ* earth, table and grid, a constant flow of inverse current will take place by this route and the rise of direct potential and the flow of electricity it produces is not so much interfered with. It would appear that, in the case of the higher potential direct current, the electrons have sufficient speed to jump the resistance, and therefore the current takes the more direct path; just as a motor car which has gathered sufficient speed is able to take a hill on "top" which it could not take otherwise.

"*Unipolar excitation*" *of an X-ray Bulb.*—The possibility of exciting the bulb by allowing the high tension current to pass through the bulb to earth (unipolar excitation—since only one pole of the tube is connected to the coil) was then tried. The following experiments were carried out with a view to testing the relative efficiency of this method.

Apparatus Used:

Coil: Watson's 12 in. intensified.

Interrupter: Watson's Dreadnought (mercury).

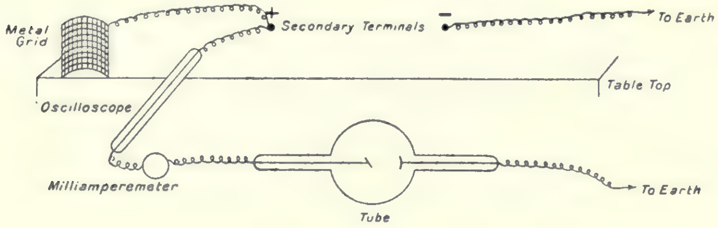
Tube: Dean's water-cooled; alternative spark gap, $4\frac{3}{4}$ ins. penetration, 5 Benoist.

Amperes in primary circuit, 4.

Percentage humidity of atmosphere, 69.4.

The oscilloscope photographs were given $\frac{1}{2}$ min. exposures.

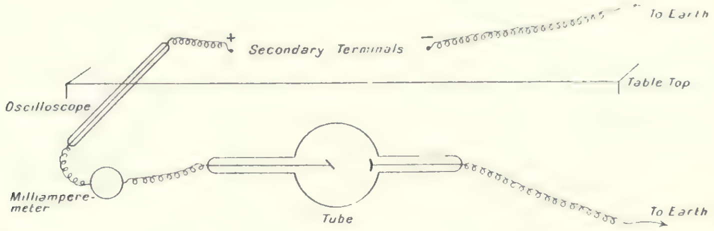
Experiment No. 1: Plan of Arrangement of Apparatus.



Results: *a.* Milliamps. in secondary circuit, 2 (needle steady).
b. Oscilloscope shows a mere trace of inverse current.

Photograph of oscilloscope.

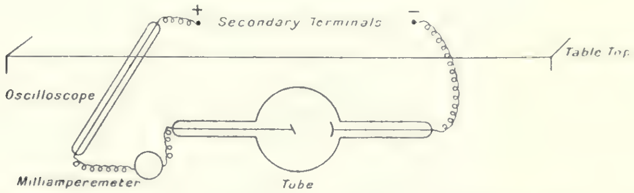
Experiment No. 2: Plan of Arrangement of Apparatus.



Results: *a.* Milliamps. in secondary circuit, 1·8 (needle fairly steady).
b. Oscilloscope shows a little inverse current.

Photograph of oscilloscope.

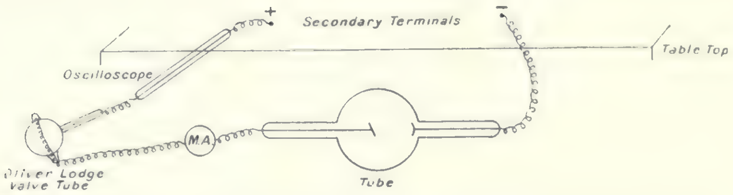
Experiment No. 3: Plan of Arrangement of Apparatus.



Results: *a.* Milliamps. in secondary circuit, 0·5 to 1·5 (needle very unsteady).
b. Oscilloscope shows much inverse current.

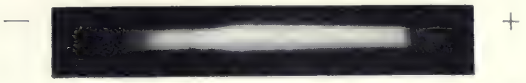
Photograph of oscilloscope.

Experiment No. 4: Plan of Arrangement of Apparatus.



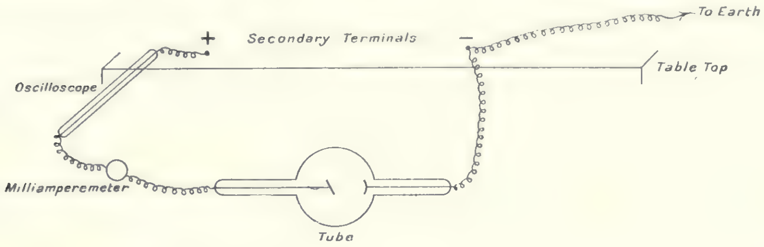
Alternative spark gap of valve tube, $\frac{1}{8}$ in. easy way, 2 in. hard way.

Results: *a*. Milliamps. in secondary circuit, 1·8 to 2 (fairly steady).
b. Oscilloscope shows more inverse current than in 1, 2, 5 or 6.

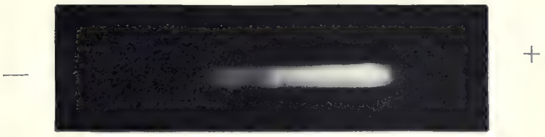


Photograph of oscilloscope.

Experiment No. 5: Plan of Arrangement of Apparatus.

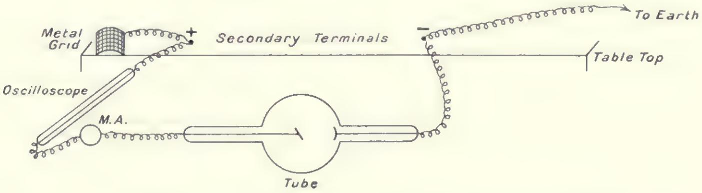


Results: *a*. Milliamps. in secondary circuit, 1·5 to 2.
b. Oscilloscope shows a little inverse current.



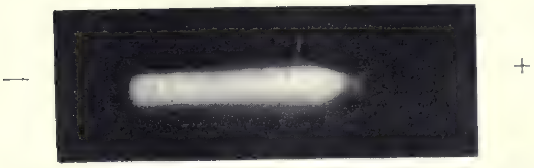
Photograph of oscilloscope.

Experiment No. 6: Plan of Arrangement of Apparatus.



Results: *a*. Milliamps. in secondary circuit, 2 (needle steady).
b. Oscilloscope shows only a trace of inverse current.

Photograph of oscilloscope.



Photograph of oscilloscope in circuit with Coolidge Tube.

This shows the appearance of the oscilloscope when no inverse current is passing.

Conclusions.

The deductions to be drawn from these experiments are as follows :—

1. Unipolar excitation is a more efficient method of exciting an X-ray bulb than the ordinary method.

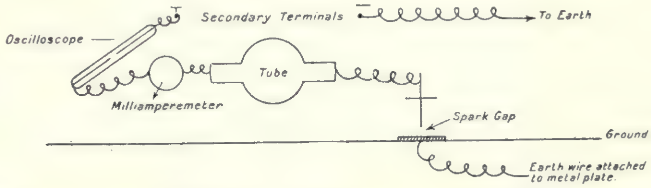
2. This method has no special advantages over the method of earthing the negative pole of the tube. It may be more convenient in certain cases. The writer, for instance, uses it for overhead work.

3. If a metal plate or grid, electrically connected with the positive pole, is placed on the coil table, inverse current is almost completely cut out with both the unipolar method and earthing the negative pole of the coil. The current in the secondary circuit is increased and becomes steadier than before.

4. As regards suppression of inverse current the arrangement is more efficient than an Oliver Lodge valve tube.

The introduction of a spark gap in series with the tube on the negative side reduces the milliampereage without having any appreciable effect on the inverse current, as the following experiments show :—

A. *Arrangement of Apparatus.*



Primary current. Amperes.	Secondary current. Milliamperes.	Inverse current.	Fluorescence of Tube.
4½	3	A little	Unsteady.

B. *Arrangement of Apparatus.*

Same as above, but without spark gap.

Primary current. Amperes.	Secondary current. Milliamperes.	Inverse current.	Fluorescence of Tube.
4½	6	Less than A.	Steady.

Insulation of Couch and Patient with Unipolar Excitation or Earthing of the Negative Pole.

The precautions to be taken in insulating the couch and patient vary with the type of couch used. Couches may be divided into three classes, as follows:

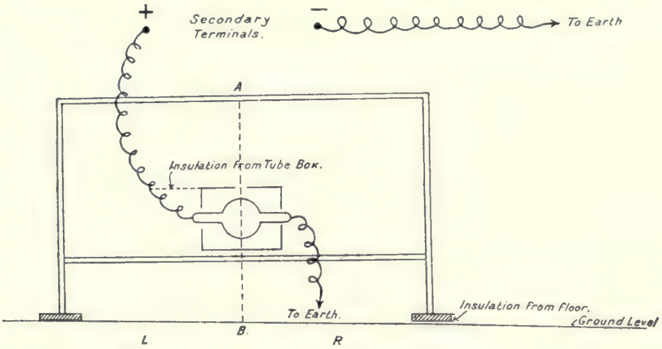
1. All wood or wood and canvas.
2. Partly wood and partly metal.
3. All metal.

There are certain general principles which apply to all three classes. For instance, since the negative side of the high tension circuit is earthed great care must be taken in insulating the positive side from the earth. If this insulation is insufficient the greater part of the direct current will pass to earth before it reaches the tube. The author's rule is as follows :—If the hardest tube likely to be employed has an alternative spark gap of 8 inches, then an insulating resistance greater than that which corresponds to an air gap of 8 inches must be interposed between the positive side of the high tension circuit and any possible route to earth. This problem offers no difficulties in dry climates. In damp climates like Bombay unpolished ebonite supports, about $1\frac{1}{2}$ times to twice the above length, are sufficient insulation from the coil table, couch, and tube box. The X-ray tube must also be thoroughly insulated from the tube box. The writer slings the tube from two ebonite rods placed across the box inside by means of silken loops. Special precautions, of course, have to be taken to keep the tube box and apparatus dry. The author has had no difficulty in effecting efficient insulation even in the dampest weather in Bombay. As a further precaution the X-ray couch should be insulated from the floor. In this way two series of resistances are opposed to the earthing of the current before it reaches the tube, viz :—

1. The resistance of the insulation from the couch and tube box.
2. The resistance of the insulation of the couch from the floor.

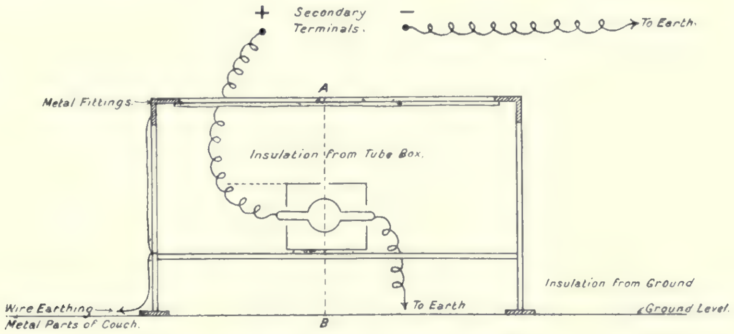
In the case of couches into the construction of which metal enters to any appreciable extent, the metal parts should be connected together and earthed to carry off induced currents.

The following diagrams represent the arrangements for the different types of couch :—



1. All wood or wood and canvas.

In this case the positive lead is thoroughly insulated from the couch and the couch from the earth. Any part of the tube or high tension circuit to the right of the line, A B, can be freely handled while the full current is passing without the risk of shock.

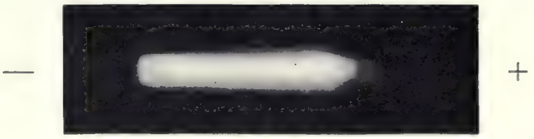


2. Couch with metal parts.

In this case, in addition to careful insulation of the positive side of the high tension circuit, all metal parts of the couch are wired together and earthed. Here, also, the high tension circuit to the right of A B, and metal parts of the couch, can be handled without risk of shock.

The Case of the Coolidge Tube.

Here we are confronted with an entirely different problem. In the first place, the Coolidge Tube, under ordinary circumstances, does not pass inverse current. This absence of inverse current is well shown by the oscilloscope:



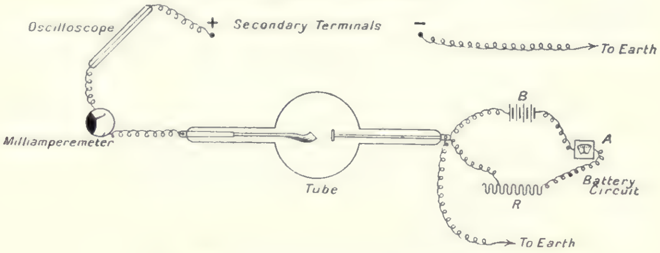
Photograph of oscilloscope in circuit with Coolidge Tube.

The Coolidge Tube, therefore, offers a high resistance to the passage of inverse current. Now it is known that a series resistance, such as a spark gap, in the high tension circuit causes the potential to rise (at the expense of the milliampereage if the inductor unit output is not altered). With the Coolidge, then, the inverse potential will tend to increase during the time it is effective, viz., until the polarity of the coil is reversed by the breaking of the primary current. This increase of inverse potential must militate against the rise of direct potential and reduce the efficiency of the coil. It accounts for unsteady running, which is sometimes observed at high voltages.

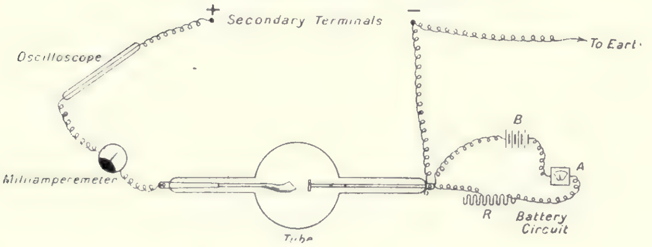
The ideal exciting inductor unit for use with the Coolidge Tube is one that produces no inverse current. For reasons mentioned before the types of apparatus which give a unidirectional current are unsuited for use in the United Kingdom, and especially in India. Single impulse coils are not yet universal, so that for some years, at any rate, a large number of Coolidge Tubes will be run off ordinary coils. All authorities agree that, with small coils particularly, inverse current must be as nearly as possible suppressed if the best results are to be obtained. For this purpose valve tubes are recommended. This point will be returned to later. Meantime, let us turn to another aspect of the case. The makers of the Coolidge Tube, and all writers on the subject. agree in stating that "*It must always be borne in mind that the entire battery circuit is brought to the full potential of the tube and that it, therefore, has to be as thoroughly insulated from the patient and the ground as the tube itself.*" This, if it were a fact, considerably restricts the uses of the tube and practically limits it to overhead work, or to stationary work from beneath the couch. Except with special types of couch ordinary screening from underneath the couch cannot be carried out satisfactorily, owing to limitation of movements and the danger of coming into contact with the heating circuit or its connections. In tropical climates matters are still worse owing to the tendency of high tension currents to leak in damp surroundings. In Bombay, for instance, during the monsoon season (1st June to 15th October) the percentage humidity of the atmosphere is frequently as high as 95 per cent., and throughout the year seldom falls below 70 per cent. With these high percentage humidities wood becomes a good conductor of high tension currents. It is practically impossible to use any of the ordinary overhead stands when the humidity is over 80 per cent., except with very soft tubes. It is, therefore, easily understood that the Coolidge Tube battery system would make difficulties in this respect almost insurmountable. Major Walter makes this point clear in his book, when he says, "This is a serious difficulty in practice during the rains in this country."

The writer believes he has solved this difficulty by earthing the negative terminal of the coil or tube, and thus bringing the whole heating circuit, including the cathode of the tube, to zero potential. There are two main ways in which this may be arranged, viz. :—

1. *Open Circuit.*



2. *Closed Circuit* (*earthed*).



In either case there is no longer any leakage of high tension current, and the whole battery circuit, including the tube on the negative side, can be freely handled, no matter what current is passing. The battery system need no longer be specially insulated—no more than any 10 to 12 volt circuit. The writer has not had the opportunity of working with a unidirectional apparatus, but from these facts he assumes that, under ordinary circumstances, the high potential current which charges the heating circuit, leading to brushing, etc., is the inverse current. The direct current will already have passed across the resistance of the tube and will not tend to earth on the negative side.

The writer recommends the open circuit arrangement for overhead work, as it will be found convenient to have only one connection from the tube stand to the coil, viz., the positive lead. For work from beneath the couch, on the other hand, with types of table arranged for ordinary tubes, the closed circuit arrangement will be found to be more convenient.

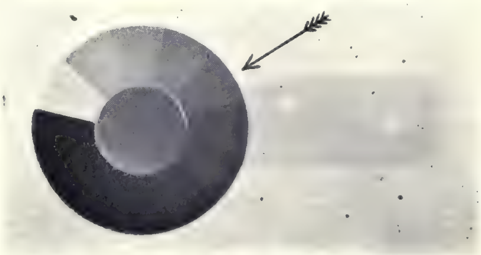
The heating circuit cable may be allowed to lie loose on the floor, or it may be carried through ring supports large enough to allow of free movement of the tube box. The whole controlling system can be placed inside the protective cabinet or behind protective screens—a fact of enormous practical importance.[1] Direct heating of the tungsten spiral from the mains is also simplified.

The following table shows one of a series of experiments carried out to compare the relative efficiency of the tube connected as above and in the ordinary way. It also includes two experiments in which a metal grid attached to the positive pole of the coil was allowed to lie on the table on which the coil rested. The use of this will be explained afterwards. In these experiments the heating current and the primary current were maintained at a constant value. The skiagrams of the Benoist radiometer were all given identical exposures and developed in the same dish. The prints also were toned together in order to get them as uniform as possible. The photographic results were all confirmed on the fluorescent screen.

		Heating current. Amperes.	Primary current. Amperes.	Secondary current. Milliamperes.	Penetration. Benoist.
A.	Closed circuit earthed.	4·3	21·5	4·5	5
B.	Open circuit.	4·3	21·5	4·3	5
C.	Ordinary connections.	4·3	21·5	4·2	4
D.	Closed circuit with grid.	4·3	21·5	4·6	5
E.	Open circuit with grid.	4·3	21·5	4·5	4 to 5

Skiagrams of Benoist Radiometer showing the increase of Penetration when the Negative Side of the High Tension Circuit is earthed.

A. (Closed circuit earthed.)



Penetration: 5.

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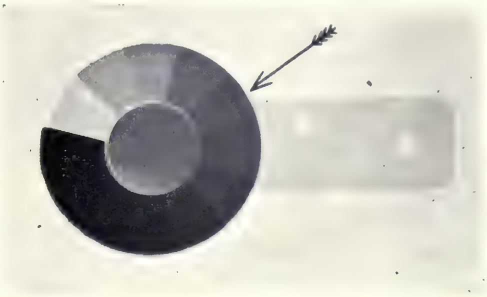
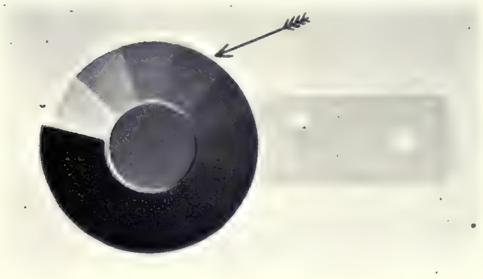
[1] The chief difficulty in heating the tungsten filament direct from the mains has been the impossibility, hitherto experienced, of insulating the heating circuit efficiently. With the connections now suggested this is no longer necessary. The heating circuit can be directly connected with the mains through a suitable resistance, or indirectly through a step-down transformer or motor generator, according to whether the current laid on is alternating or continuous. The connecting cables must of course be of suitable size and sufficiently insulated to carry a current of from 3 to 5 amperes at a pressure of 10 to 12 volts.

B. (Open circuit.)



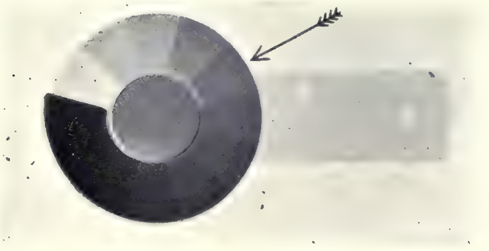
Penetration : 5.

C. (Ordinary connections.)



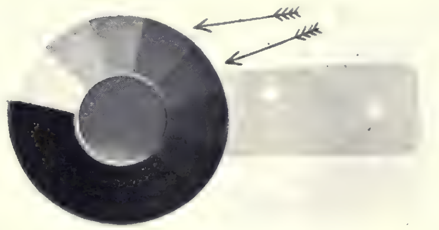
Penetration : 4.

D. (Closed circuit with grid.)



Penetration : 5.

E. (Open circuit with grid.)



Penetration : 4 to 5.

From the above figures it will be seen that there is no loss of efficiency on earthing the negative pole of the coil. On the contrary there is a gain as regards both milliampereage and penetration. This is due to the fact that the inverse current is now diverted to the earth and does not interfere with the passage of direct current. As the negative pole of the tube is now at zero potential, the effective potential applied to the tube must have a greater value than is the case with the ordinary connections when the potential of the negative pole has a positive value. As regards actual practice the writer has now taken a large number of skiagrams with the tube underneath the couch and connected as in D. The results have been most satisfactory. Screen examinations can also be carried out with the greatest facility.

As the practical advantages to be derived from earthing the negative terminal of the coil are beyond question, we must now consider whether we are in danger of putting undue strain on any part of the apparatus. There are only two parts of the apparatus which are likely to be affected, viz., the coil and the bulb. It has been proved satisfactorily that the fall of potential through the tube is increased. This theoretically means increased strain on the tube. After five months' experience with many varieties of tube and a series of over 300 cases, including a small number of treatments, the writer is convinced that there is no danger of damaging the X-ray tube in any way. Not a single tube has punctured while running as suggested ; on the contrary the tube runs much more steadily owing to the suppression of inverse current. Undue strain on the tube may therefore be discounted. With regard to the coil the writer has seen a coil (Watson's 16-inch intensified) break down while being run in the manner suggested with a Coolidge Tube. The insulation of this coil had, however, been damaged by intense heat during transport from Delhi in the hot weather. The paraffin wax at both ends of the secondary had melted and dropped out. This accident, however, led the writer to consider if precautions could be taken to avert danger of breakdown due to increased strain on the insulation. The increased fall of potential between the positive and negative terminals of the coil is shown by the increased penetration of the tube (increase of penetration must mean increased velocity of the cathodal stream and increased potential applied to the positive terminal of the tube). Now it has already been pointed out that it is probable that the potential of the inverse current is worked up owing to the enormous resistance opposed to its passage by the Coolidge Tube. It has also been shown that it is difficult to effect good insulation of high tension apparatus when the humidity of the atmosphere is high. Wood becomes a semiconductor under these conditions. The coil table will become charged with inverse current through the earth ; and if, as in the type of coil under consideration, the core is exposed, leakage will take place to this, and the electrical tension around the positive end of the coil will be greatly increased —this being the return end for inverse current. In the case of the broken down coil the author heard sparking take place inside the positive end of the coil—presumably between the iron core and the positive end of the secondary winding through the damaged insulation material. The obvious way to prevent this is to connect the wooden table electrically with the positive terminal of the coil. This can be done efficiently by placing a metal grid, or plate, on the table or under the end of the coil and connecting it by means of a wire with the positive end of the coil. It was thought at first that this might lead to inordinate leakage of direct current to earth. Experiment has proved that this is not the case. In all cases not only was there no appreciable diminution in the milliampere readings but the needle was much steadier, and in some cases there was a positive increase (see experiments with Coolidge Tube above). By thus "earthing" the coil table to the positive terminal of the coil we not only provide protection for the coil but also offer an alternative path to the inverse current.

We have also another safeguard, viz., in the safety valve action of the alternative spark gap with which all coils are fitted. The insulation of any well made coil should be able to withstand an electrical strain corresponding to its nominal spark gap. If, therefore, we set the discharging points at a distance less than this, the potential—inverse or direct—can never reach a point which would endanger a breakdown.

The question of insulation of the couch from the earth, and insulation of the positive lead from the couch and the patient, has already been dealt with. The remarks about the insulation of the old type of tube apply with equal force to the Coolidge Tube.

In conclusion, it may be said that though it is highly probable that single impulse coils will in time replace the old type of coil, so that the X-ray worker will no longer be troubled with inverse current, it is equally certain that the Coolidge Tube, or some modification of it, will replace all the older types of tube. The writer is confident that when the method herein described of dealing with inverse current has been relegated to ancient history, the labour involved in the observations recorded will not have been in vain, as the results—the simplification of the use of the Coolidge tube and its universal application—thereby ensured will continue to exist.

SOME NEW MECHANO-THERAPEUTIC APPARATUS.

By Major J. **Hall-Edwards**, R.A.M.C.

Eighteen months experience as P.M.O. at a Command Depôt has convinced me that there is much room for improvement in the physical apparatus used for remedial treatment. A Command Depôt differs very much from a Convalescent Hospital, the chief point of difference lying in the fact that all the inmates are presumably men, who should, after a period of treatment, be rendered fit to return to the Army in one of the categories set forth in Army Council instructions. The patients admitted to these Depôts are, or should be, all fit to live a hutted life, and with the application of the special treatment given, a certain percentage of men should be found fit to return to general service.

The treatment consists of massage, electrical treatment of various kinds, special physical exercises with apparatus, and special physical exercises under the personal supervision of Sergeant Instructors. When the men are pronounced medically fit, they then undergo, at the Depôt, a course of training to once more fit them for active service. The amount of work they have to do before being placed in the highest category is laid down in Army Council instructions, and unless they are able to fulfil these conditions they are placed in a lower category suitable to their slight infirmities. No man is admitted to a Command Depôt who has not seen active service, and it naturally follows that none of them are too keen to become fit again and return to the trenches.

In carrying out any method of treatment this fact must be always before one, otherwise the surgeon might be led astray by the magnification of the symptoms which naturally accrue.

In order to produce the best results it is absolutely necessary that personal supervision be given to each case, and that the exercises advised be carried out in such a manner that the movements of the limbs are of a progressive character. By this I mean that little good is obtained by merely placing a man in front of a machine and telling him to exercise the injured joint. Unless he be carefully watched to see that the movement is forced to the greatest possible limit, he may carry out such exercises for a month without obtaining the least benefit. For instance, in the case of a stiff wrist following a slight gun-shot injury or an old fracture, if the man be placed before one of the wrist exercisors of the conventional type and be simply told to wind the weight up for a certain length of time, he will do this without the slightest benefit to himself, and, on carefully watching him, it will be found that the chief movement comes from the shoulder and elbow and the wrist-joint is kept perfectly stiff. If, however, precautions be taken so that he cannot move the shoulder and elbow-joint, he will immediately begin to obtain benefit.

Again, a man with a partial stiff knee-joint is placed in one of the conventional rowing machines for exercises. He may carry out these exercises for several days without the slightest benefit arising. If, however, an attendant or instructor supervise his movements, and exert a little pressure on the injured knee-joint each time he extends the leg, it will be found that he will rapidly improve.

The object of this short paper is to describe some pieces of apparatus I have devised, which not only act as exercisors but which also indicate, by means of a dial, the amount of movement in the joint being exercised. One of the chief points aimed at in devising this apparatus was to so construct it that it would tend to make the patients interested in their own cases, which is a great feature in helping to bring about a cure. From this point of view the apparatus has been found to be highly beneficial, and, although it has only been put to practical use on a few occasions for the purpose of experiment, it was observed that men with stiff joints were competing with one another

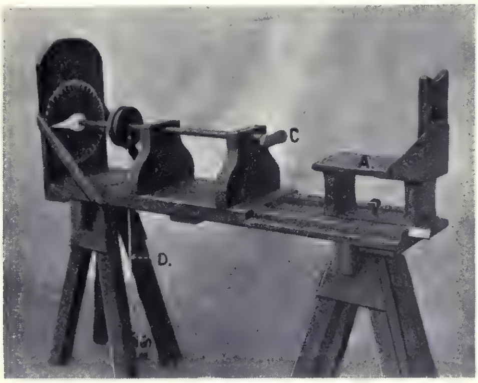


Fig. 1.
Machine for exercising and measuring the movements of Pronation and Supination. (*a*) Rest for Elbow with Padded Base and Back-Board (*b*) to which the upper arm is strapped. (*c*) Grasping Handle. (*d*) Cord carrying Weight.

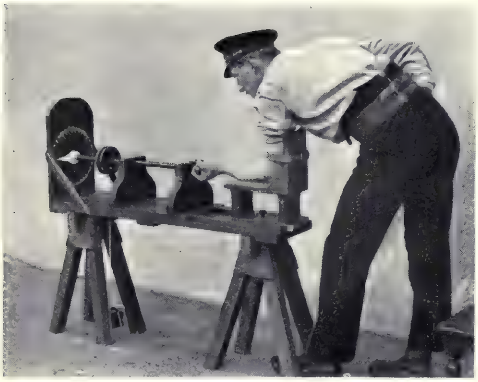


Fig. 1 (*a*).
Machine for exercising and measuring the movements of Pronation and Supination, showing the Arm fixed in position to measure Pronation, and the pointer at zero.

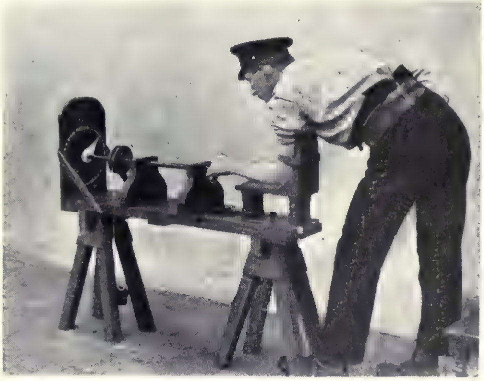


Fig. 1 (*b*).
Machine for exercising and measuring the movements of Pronation and Supination, showing the extent of Pronation indicated on the Dial.

to see what amount of movement they could register upon the dials. I have, so far, completed three pieces of apparatus, which are of value in measuring the following movements :—

1. Pronation and supination of wrist.
2. Flexion and extension of elbow-joint.
3. Foot-drop machine.

The dial system can easily be applied to other pieces of apparatus, such as those devised by Major Tait McKenzie. The pieces of apparatus here figured and described are of home construction, being made in a carpenter's shop at the Command Depôt with such material as we had at hand. They are all capable of great improvement, and no doubt when manufactured by experts will render greater service than these roughly made specimens have done.

I may here say that these machines will shortly be put on the market by Messrs. S. Megarity & Co., Higher Broughton, Manchester, who will also apply the dial system to other pieces of apparatus which they are now making.

Fig. 1.—*Machine for Exercises—Pronation and Supination of the Wrist.*

The machine consists firstly of a rest for the forearm (*a*), and a right-angle board at the back of this to which the upper arm can be fixed by means of straps (*b*). The table which carries this rest is capable of being moved to and from the handle (*c*), so as to allow of its being adjusted for various lengths of forearm. The support for the forearm is padded so as to enable the arm to be moved easily. The handle is so constructed that it can be easily grasped by the hand and either from above or below. On turning the handle the weight (*d*) is raised, and the indicating finger shows the angle to which the arm can be turned. By a simple arrangement the same machine is made to act for both hands. The amount of pronation and supination can be read off on the dial.

Fig. 2.—*Machine for Exercising Elbow-joint.*

The machine consists firstly of a table, part of which, as shown, is padded, upon which the extended arm lies. The handle (*a*) is grasped in the hand and the elbow flexed, the amount of flexion being registered on the dial. The dial is divided simply into inches, as the angle to which the elbow can be flexed cannot well be shown here, inasmuch as the length of the arm differs in different men. The weight lifted (*b*) can be increased or decreased at will. In using these machines for measuring the amount of flexion, care must be taken that when the arm is bent to a right angle the wrist is kept straight with the forearm, otherwise wrong measurements may be made.

Fig. 3.—*Apparatus for Foot-drop.*

The foot is attached to a hinged board (*a*) by means of straps, and the weight (*c*), which also actuates the movements of the dial, can be so adjusted

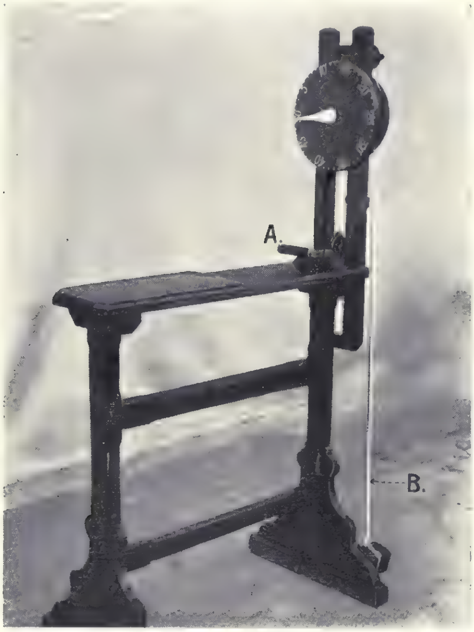


Fig. 2.
Machine for exercising Elbow-joint, showing padded Table. The Handle in normal position (*a*) and the Cord carrying the Weight (*b*). The raising of the Weight works the Finger round the Dial.

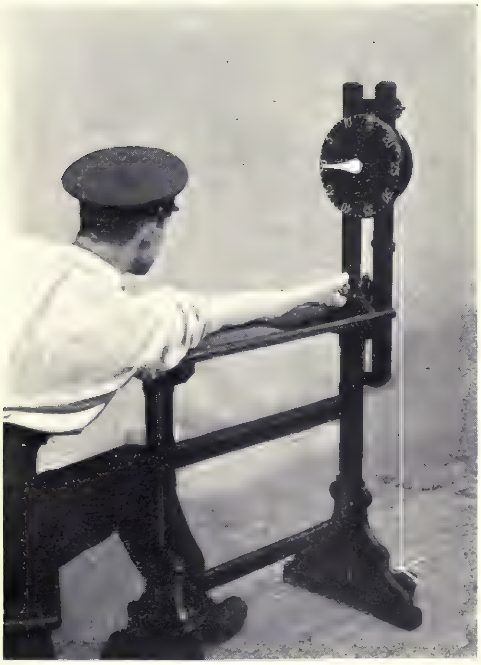


Fig. 2 (*a*).
Showing Arm in position with Handle in Hand. The Pointer on the Dial is at zero.

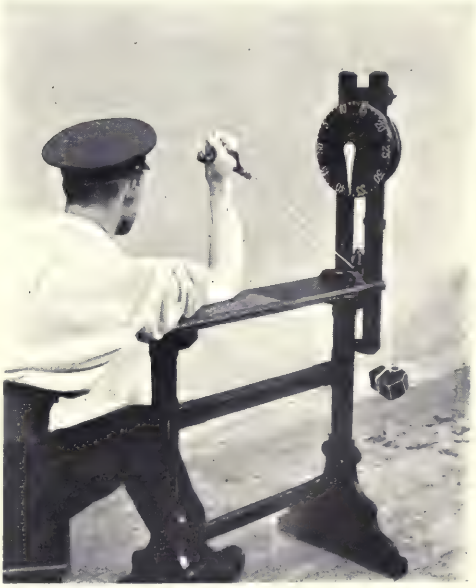


Fig. 2 (*b*).
Shows the Machine in use with the Elbow bent to a right Angle and the Weight lifted from the Floor.

as to either lift the foot so that the foot-board can be pressed down or the weight may be lifted when the foot is raised. The stool upon which the patient sits moves forwards and backwards towards the dial between runners, so that the distance between the stool and the foot-piece can be adjusted to any length of leg. This machine can be easily adapted to show rotary movement of the joint.

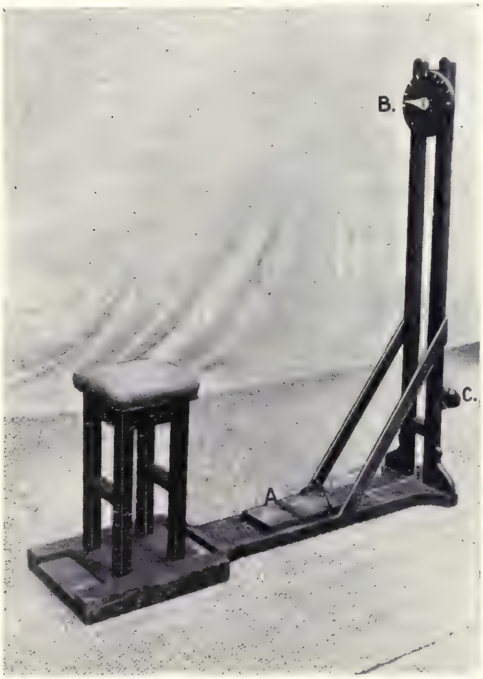


Fig. 3.
Foot-drop Machine. (*a*) Shows the hinged Board to which the Foot is strapped. To the end of this Board is fixed a Cord which actuates the Dial (*b*) and lifts the Weight (*c*). The Stool can be moved backwards and forwards between the Runners shown.

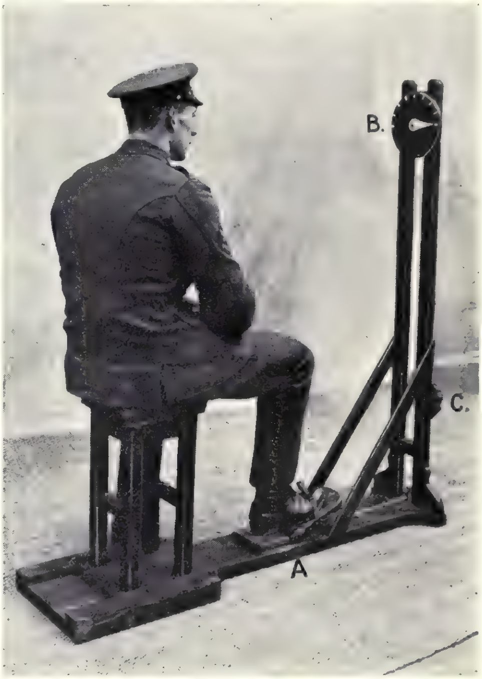


Fig. 3 (*a*).
Shows the Machine being used, the Finger on the Dial indicating the amount of Movement.

The interest created by watching the movement of the dial is a direct stimulus for the patient to do his best, and it enables the attendants to see at a glance whether or not a man is doing the full amount of exercise which they know he is capable of.

I am hoping that these machines may shortly be placed on the market, when I am sure they will prove of great service in helping to restore wounded men to health.

ROENTGEN OBSERVATIONS ON THE DUODENUM, WITH SPECIAL REFERENCE TO LESIONS BEYOND THE FIRST PORTION.

By JAMES T. CASE, M.D., F.A.C.S. Battle Creek, Mich.

(*Continued from p.* 49.)

Dilatation of the Ampulla of Vater.—In considering the ætiology of pancreatitis, it will be recalled, as Opie first suggested, that a small gall stone may lodge in a large diverticulum of Vater, obstructing the opening of the diverticulum into the duodenum and converting the diverticulum into a through channel from the common bile duct into the pancreatic ducts. The forcing of infected bile directly into the pancreatic duct under such circumstances is doubtless a common cause of acute pancreatitis. That this obstruction may result from other causes than the impaction of gall stones is probable.

Oddi has shown that there exists about the ampulla a sphincter, formed by a thin layer of involuntary muscle. Is it not possible that spasm of this sphincter may occur under certain circumstances?

Williams and Bush (*Journal of Medical Research*, Vol. XVII, No. 1, October, 1907) suggest another mechanism, viz., that the passage of gall stones may so dilate the opening of the diverticulum of Vater that intestinal contents may pass into the pancreatic duct, resulting in an inflammatory reaction. They cite numerous anatomical and experimental evidences that make it seem probable that some cases of acute pancreatitis have been caused in this way.

Edward Archibald, of Montreal, is a strong believer in spasm of the sphincter at the duodenal end of the ampulla of Vater as a cause of pancreatic disease. He believes that the irritation which results in this sphincteric spasm may be supplied by duodenal ulcer, which is not at all infrequent in cases of pancreatitis. That spasm should alternate with undue relaxation seems quite natural. The writer has seen perhaps fifteen cases where a very appreciable amount of opaque salt entered the ampulla of Vater. In the majority of instances, these cases have exhibited clinical signs of chronic pancreatitis. Is it not probable that there is a definite relation between dilatation of the ampulla of Vater and chronic pancreatic disease? If the dilatation of the ampulla be the result of chronic spasm of the common duct sphincter, then it is necessary to suppose, as Dr. Archibald suggests, a periodical undue relaxation of the sphincter in order to explain the entry of the opaque salt.

The formation of the ampulla of Vater and the termination of the common bile duct and the pancreatic duct may occur in at least six variations, as related by Robson and Cammidge. The *first* is the classical type, in which the last segment of the common bile duct, comprising all that portion of the canal contained in the thickness of the wall of the duodenum, passes obliquely through the muscular coat of the intestine and then dilates into a little reservoir underneath the mucous membrane, into which the main pancreatic duct also opens, known as the ampulla of Vater. In the *second* type, the pancreatic duct joins the common bile duct some little distance from the duodenum, but the ampulla of Vater is absent, the duct opening into the duodenum by a small, flat, oval orifice. In the *third* type, the two ducts open into a small fossa in the walls of the duodenum while the papilla of Vater and the ampulla of Vater are absent. In the *fourth* type, the papilla is well developed, but the ampulla is absent, the two ducts opening side by side at the apex of the papilla. In the *fifth* type, the common bile duct opens along with the duct of Santorini and the duct of Wirsung enters the duodenum separately. In the *last* type, the pancreas has three separate ducts opening into the duodenum, one only accompanying the common bile duct.

When the pancreatic and the common duct terminate in the first (the classical) type or in the second variety of termination, as above noted, the onset of pancreatitis in the case of common duct cholelithiasis or spastic contraction of the common duct sphincter will be favoured. The duct of Santorini is present in less than half of all the cases, hence this duct cannot be counted upon to act as a safety valve to the duct of Wirsung when it is compressed.

In one of the writer's cases the diverticulum of Vater appeared to be double. That this occasionally occurs is noted in the anatomies. This patient had not only multiple diverticula of the colon, but also multiple diverticula of the small bowel, two large ones, the size of pigeons' eggs, beyond the duodeno-jejunal junction. In still another case of dilated ampulla of Vater, there were numerous diverticula of the jejunum, but none were found in the colon.

In any case, it is of extreme interest to note that in the majority of instances of dilated ampulla of Vater, as shown by the entry of barium at the time of the barium meal, there have been clinical signs of chronic pancreatitis.

It is of further interest that in many cases showing dilated ampulla of Vater, there have also been demonstrated multiple diverticula of the colon, and in two cases multiple diverticula of the jejunum. In some of these cases the symptoms of colonic diverticulosis were over-shadowed by epigastric symptoms strongly suggestive of a pancreatic lesion. Although the cases are as yet too few to warrant any deductions, it is of great interest to recall that out of fifteen or sixteen cases of unusual patency of the papilla of Vater, with filling and stasis of the opaque salt in the diverticulum of Vater, about half the patients were clinically suffering from chronic pancreatitis, whereas the other half had multiple diverticula of the colon, and some of them had symptoms of both lesions.

A close watch of similar cases with reports of findings by many observers will, let us hope, soon permit definite conclusions as to the worth of this observation.

The question has also arisen as to the possibility of barium entering the common duct and passing into the gall bladder. It is not only possible, but

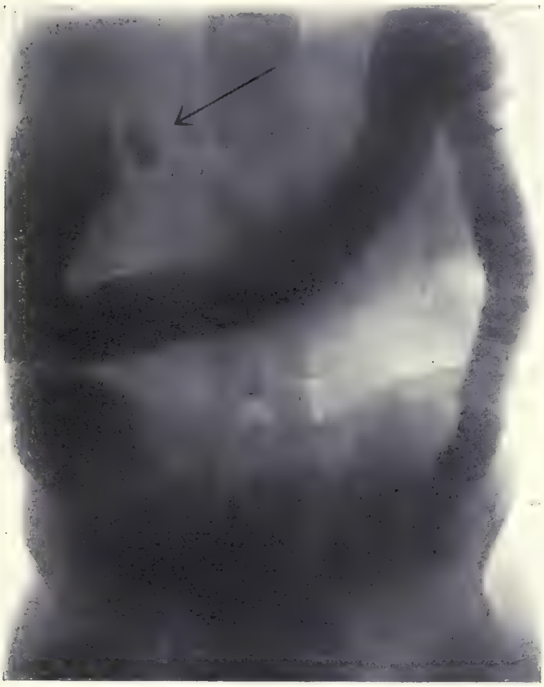


Fig. 17.—Dilated Ampulla of Vater, with Stasis Longer than Four Days, in a Case of Multiple Diverticula of the Colon.

In this roentgenogram the colon is shown filled by the barium enema.

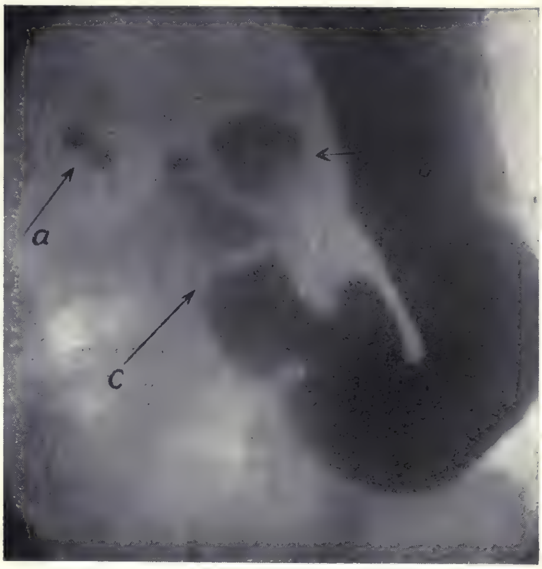


Fig. 18.—Double Ampulla of Vater.

(*a*) Double ampulla of Vater. (*b*) Large diverticulum of the duodenum near duodeno-Jejunal junction. (*c*) Pylorus. Operated Case.

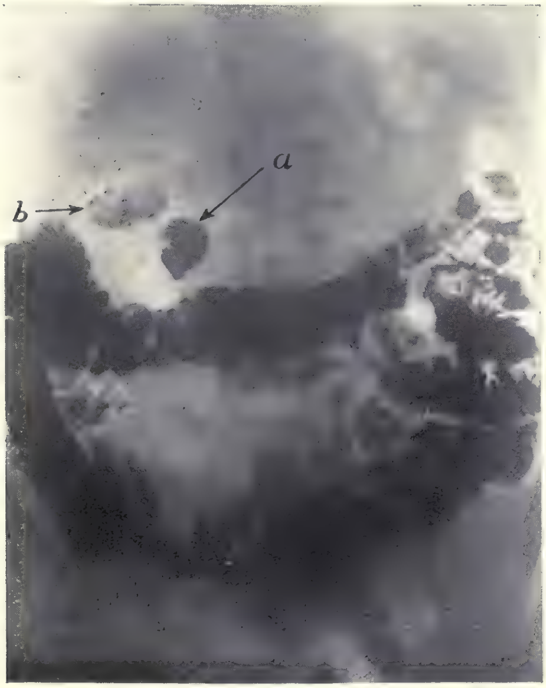


Fig. 19.—Gall Bladder, Visualized by Entry of Barium.

(*a*) Large diverticulum of the duodenum, third portion. (*b*) Gall bladder containing stones, visualized by entry of the barium following barium meal.

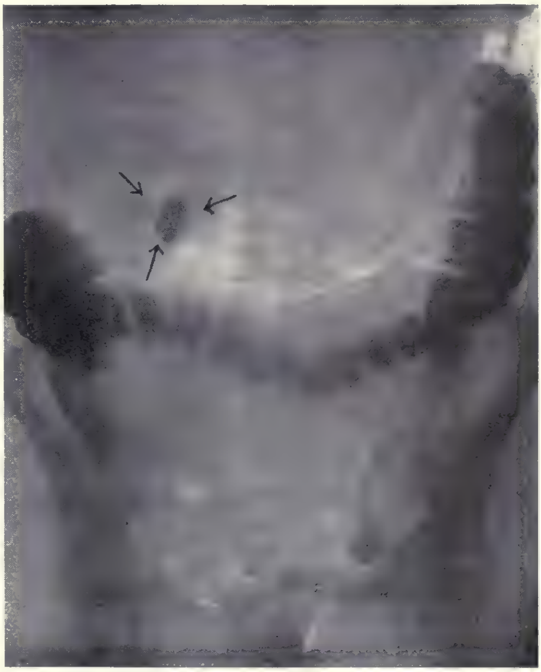


Fig. 20.—Gall Bladder (at Arrows), Filled through Cholecystenterostomy Opening.

quite the rule, for barium to fill the gall bladder after the operation of cholecystenterostomy. The writer has demonstrated this in the two cases where he has had the opportunity to make a post-operative examination in such cases. The barium was retained longer than forty-eight hours in one instance, and in the other longer than four days. In one instance, the records of which will be shown on the screen, it is probable that barium entered the gall bladder and visualized gall stones which had previously been invisible roentgenologically. The patient did not consent to operation.

Some of the points in the foregoing pages are new as far as the roentgenological aspects are concerned. They are presented here not because they are settled facts, but in an effort to broaden the field of diagnostic possibilities with reference to the duodenum. The differential diagnosis of right upper quadrant lesions will ever be a most interesting and intricate subject, and if roentgenologists can bring to the internist any additional information by means of our special methods of study, we will be making a valuable contribution to the diagnostics of internal medicine.

REVIEW.

Manuel d'Electrothérapie et d'Electrodiagnostic. By Dr. E. Albert-Weil, Chef du Laboratoire d'Electroradiologie de l'hôpital Trousseau. Third Edition, pp. 382, with 107 illustrations. Paris: Librairie Félix Alcan, 108, Boulevard St. Germain.

The third edition of Dr. Albert-Weil's "Handbook of Electrotherapy and Electrodiagnosis" has been completely revised. The work has been shortened by the omission of the section on the X rays, but two new chapters have been added, one on electrocardiography, the other on the detection, by electrical methods, of metallic foreign bodies in the tissues. Many chapters have been modified, and additional information has been given on many subjects, such as high-frequency currents of high tension, diathermy, galvano-therapy with low current density, ergotherapy, etc. Other chapters have been re-written, so that the present edition is practically a new work.

Part I. deals with physical principles, electro-medical apparatus, and the methods of applying the various currents to the body. The various electrical machines and devices are well illustrated and clearly described. The author calls attention to the importance of correct design in the construction of medical coils, and he rightly condemns the forms of many that are sold for the purpose of treatment. A dynamo that generates a current resembling the faradic current is described; in it the reverse current is suppressed. A high-frequency apparatus is described containing two resonators and two sets of condensers; it is said to give a bipolar effluve of great power. The static machines shown are not of the best design; the plates are too small, and such machines would not give a sufficiently high voltage for the efficient application of the static wave current.

Part II. deals with the physiological effects of the various currents and the indications for their therapeutic use. Of particular interest is the section dealing with the action of the galvanic current on the excitable tissues. The importance of the measurement of electrical stimuli, both as to their duration and their strength, is duly recognised; and the author alludes to the work of Lapicque on the subject in connection with the reactions of muscle and nerve. It is to be noted that the author states that the measurement of the time-constant known as the *chronaxie* shows whether the degeneration of a muscle following nerve injury is increasing or diminishing.

Part III. comprises an account of the uses of electricity in diagnosis. The various electrical reactions are fully described, including those less familiar, *e.g.*, the reactions of Rich and of Geigel, the reaction of compression, the latent faradic reaction, etc. The myasthenic reaction is not so called; it is termed the reaction of exhaustion (épuisement), and is said to be present in some cases of paralysis following disease of the cerebral hemispheres, hemiplegia following cerebral hæmorrhage, progressive muscular atrophy, as well as in myasthenia gravis. I.. Part III. is a new chapter—that on the string galvanometer and electrocardiography. The author scarcely does justice to the value of the string galvanometer in diagnosis, and mention might have been made of its use in analysing the various forms of cardiac arrythmia; in this it is equalled by no other instrument.

Part IV., containing 141 pages, deals with the treatment of all the maladies and morbid conditions for which electricity is suitable. The author shows moderation and does not hesitate to say when other forms of treatment are more suitable. Frequent reference will be found to the newer forms of electrical treatment, such as diathermy and ergotherapy. The use of the latter in the treatment of obesity is fully described. The author condemns the use of faradic currents for the treatment of the limbs in hemiplegia, and states that the only current that should be used is a weak galvanic current. Part IV. is interesting reading. There is a complete chapter on the treatment of diseases of women—the electrical treatment of some sixteen maladies being described. The treatment of gonorrhœa by diathermy is described, and the author highly recommends high-frequency treatment of prostatitis.

The book is concluded by a chapter on the use of electrical methods for the detection of metallic foreign bodies in the tissues.

Dr. Albert-Weil's book is small in size, but contains a large amount of useful information. The descriptions of apparatus and methods of treatment are clear and easy to read, and the book can be cordially recommended to English readers who desire acquaintance with the French school of electrotherapy.

NOTES AND ABSTRACTS.

RADIO-DIAGNOSIS.

Study of the Changes that Occur in Infected Bony Injuries and their Treatment.—VIRENQUE AND JAUGEAS (*Jour. de Radiol. et d'Elect.*, Sept.-Oct. 1916, p. 273).—The authors have carefully observed these changes by clinical examinations, surgical findings, and X-ray examinations at repeated intervals, in order to arrive at a basis for the proper treatment of such cases. To illustrate their findings a few cases are described in detail.

This article is an important addition to our knowledge of the changes that take place at these injuries, so frequently seen at present, and the following is a summary of the authors' conclusions.

At the seat of a badly comminuted fracture one should observe not only the fragments of the shaft, whose fractured surfaces are irregular, markedly projecting, and often having a terminal bony spinous projection, but also the splinters which may be either free or adherent. Of the adherent splinters, a distinction should be made between those that are movable and those that are fixed. The former are not in contact with the shaft fragments but at the periphery of the field of comminution, they have a weak periosteal attachment, and are often markedly displaced from the seat of fracture. The latter are to be found in the neighbourhood of the fractured ends of the shaft, have strong periosteal attachment, and are not displaced.

The torn periosteum is not destroyed, except in severe and long standing infections.

Systematic radiographic examination will alone show the exact amount of bony damage and the presence and condition of these various factors.

In a comminuted fracture these changes may present very different appearances.

Generally, there is no tendency to the spread of the infection in the bony tissue when the infection comes from the outside and is traumatic in nature. This is contrary to what is seen in pathological infections, and to explain it the structure of the bone must be taken into account. If disinfection of the bone is quickly and completely obtained, with good drainage of the damaged area, the ends of the fragments will, by means of the periosteum, bring about speedy repair without further complications. Radiography shows this to be by regular callus formation, extending over a surface of even 5 or 6 cm., while the fractured ends of the shaft do not show any structural change.

But if this disinfection is not obtained, or only partially or too slowly, various complications may arise, for a persistent sinus, due to a focus of infection, may lead to the formation of large cavities in the bone, or even a false joint. The process is as follows:—The ends of the shaft fragments are infected usually over a small area, except sometimes at the medullary cavity. The whole of this area of infection becomes destroyed more or less slowly, but it is limited by a defensive, hard, compact zone of condensed bone. This reaction, though useful against infection, becomes a source of complications in the process of repair. It limits the enlargement of the cavities and makes sure of a false joint, but it is quite incapable of any reparative process, and does not allow the full action of the periosteal new bone formation.

The periosteum, long acutely inflamed, may show considerable new bone forming powers, but it is of little avail. The free splinters very soon become necrotic. The adherent splinters which are movable necrose secondarily, sometimes, however, only partially. They become sequestra by the action of the neighbouring new bone formation. The adherent splinters which are fixed participate in the events which take place in the shaft.

Radiographic examination thus shows up faulty repair, as seen in the following changes:—

At the fractured ends of the shaft, a diffuse periostitis without definite limits, the appearance of a zone of condensed bone, with loss of bony structure at the compact layer of the bone and the medullary canal.

At the area of the splinters, their condition of partial or total necrosis, their condensed appearance, or the first signs of their becoming sequestra by the neighbouring new bone formation.

In practice, then, everything depends on the rapid and complete disinfection of the seat of fracture. If too little damaged tissue is removed disinfection is prevented, and complications arise which can be revealed by X rays. If too much is removed there is a tendency to the formation of false joint, with great loss of substance and without hope of spontaneous repair. The free splinters, the adherent yet movable splinters in their deperiosteal state should be removed, but one should not touch the adherent splinters which are fixed, nor the ends of the fractured shaft, unless it be to free their surfaces from projections and bony spines without periosteal covering which are sometimes met with there.

Such treatment is only possible after careful X-ray examination, it being then still necessary to observe the changes at the seat of fracture by repeated examinations. If these methods are applied the authors think that many of the complications and sequelæ of complicated fractures will be avoided.

R. W. A. S.

Idiopathic Infantile Osteopsathyrosis.—E. S. Blaine (*American Journal of Roentgenology*, Sept., 1916, p. 438).—Three forms of osteopsathyrosis are recognized:—

(*a*) Fœtal (commonly called "osteogenesis imperfecta"), in which the disease is prenatal.

(*b*) Infantile, in which the first fractures occur most often between one and one-half and two years of age.

(*c*) Adult, which develops at a much later period.

The author describes a case of idiopathic infantile osteopsathyrosis which came under his observation. The radiographic appearances were as follows. The long bones have a very delicate appearance, a marked osteoporosis being evident. The cortex is thinned out and barely distinguishable from the medulla. The diameter of the shafts is lessened, but the length is normal. All the epiphyses are normal except at the wrists, where the diaphyseal side has a cuplike convexity toward the epiphysis. Multiple fractures, at least 13, are seen to involve several of the long bones. These are seemingly healed, although the callus is not so dense as usual, a dark area or band appearing at the ends of the fragments. The long bones are not bent or bowed, but several of the fractures have healed in malposition, thus causing deformity of the limb.

Taking into account the clinical picture, these appearances indicate this, in the author's opinion, to be a case of idiopathic infantile osteopsathyrosis, complicated with rickets.

In a typical case of the infantile form, the first sign is a spontaneous fracture of a long bone during the first two years. The fractures result from a very slight fall or slight injury, which indicates the brittleness or crumbling nature of the bone. No deformities are present until at a later period. Pain resulting from these fractures is comparatively slight and out of all proportion to such an occurrence. Slight fractures are fissures and may occur without being recognized even on the skiagram. In some of the cases reported joint ankylosis is noted.

The writer quotes liberally from an article on this subject by Kienboeck, in a recent issue of *Fortschritte auf dem Gebiete der Roentgenstrahlen*, and which he regards as a classic on this disease. Two detailed tables are quoted giving the differential characteristics between infantile osteopsathyrosis and fœtal osteopsathyrosis, and between infantile osteopsathyrosis and infantile osteomalacia.

The cause of the disease is at present unknown, and a case under Looser showed the following pathological changes. Osteoporosis and thinning of the shaft of the long bone, which was of normal length. Microscopically there was an insufficient and markedly delayed ossification of the bone cells of the osteogenetic layer of the periosteum, and a "ring" of defective bone at the apposition of the fragments. In the latter zone there was an absence of osteoclastic cells.

As to treatment, anti-rachitic measures are probably the best.

The confusion of nomenclature given to bone diseases of this nature is finally discussed, and the author believes that idiopathic osteopsathyrosis is the correct name, as it indicates the pathological condition as opposed to fragilitas ossium, osteogenesis imperfecta and others.

R. W. A. S.

Radiological Diagnosis of Gas Gangrene.—R. Ledoux-Lebard (*Journal de Radiologie et d'Electrologie*, II., 4, July-Aug., 1916).—The abnormal presence of gas in tissues is capable of demonstration on the X-ray plate or screen. The author publishes an excellent radiograph of a case in which gas is seen in muscles at a level where there were no clinical signs of its presence. He pleads for a radiographic examination whenever amputation is being considered on account of gas gangrene. It may give valuable evidence as to the nature and level of operation required and so lead to better results.

N. B.

RADIUMTHERAPY.

New York Medical Journal, July 8th, 1916.—Sinclair Tousey records a varied series of cases in which he has personally used radium and found it beneficial. The first case he quotes refers to his own hands, which were badly affected by keratoses as the result of repeated exposures to X-rays ; the growths had been removed repeatedly but invariably returned. Tousey applied a tube of radium to one of them which was on the dorsal surface of an inter-phalangeal joint of his ring finger. It had a warty appearance and apparently involved all of the tissues down to the bone. Before making the application he pared the growth down almost to bleeding point and it never grew up again. Thirty days after the irradiation he noticed that the edges were loose and picked off the entire growth like a scab, leaving a pink and tender surface in which there has been no recurrence after two years. Following this, he treated about fifteen other keratoses on his hands in the same manner with complete success. He remarks that similar treatment is curative in telangiectases and in all kinds of warts.

A deep ulcer, with indurated edges, on the ala of the nose was cured by a single application.

In the case of an elderly physician an epithelioma of the lower lip was treated by an application every few months, and, in connection with this case, Tousey remarks on the different reactions to radium of skin and mucous surfaces: in the latter there is "a molecular casting off of diseased tissues instead of a separation *en masse*, as in the former."

In cases of vernal catarrh, with the inner surfaces of the eyelids covered with masses of granulation tissue, it was found that the granulations resisted all efforts at destruction by caustics and even recurred after being cut away. "Strong applications of radium filtered only by the glass walls of the tube" were made with complete success, the eyeball being protected by a smooth metal shield during the application.

In keloids or cicatricial contractions aluminium filters are interposed so as to employ only the gamma and the more penetrating beta rays. Successful cases quoted are, a keloid in an appendicectomy scar and extensive contractures, as the result of cellulitis, in the hand of a nurse. In the latter case the result was so good that the patient was enabled to become a shorthand typist after combined treatment by surgery and radium.

The use of heavily filtered rays is mentioned but no specific illustrative cases are included.

One case is cited to illustrate the use of water with emanation dissolved in it. It is that of a lady, aged 70, who suffered from chronic sciatica and derived great benefit from drinking emanation water

H. M. B.

CORRESPONDENCE.

WAR EMERGENCY FUND OF THE ROYAL MEDICAL BENEVOLENT FUND.

To the Editors of ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY.

SIRS,—The time has come to make a further appeal for the War Emergency Fund.

This Fund was instituted last year to afford assistance to members of our profession who, in consequence of having joined the Army Medical Service, find themselves in temporary difficulties.

Many medical men, when called up, had to leave on very short notice, without time to make adequate provision for the continuance and maintenance of their practices during their absence. As a result they have had to face a severe fall in income even when supplemented by army pay; while many expenses, such as rent, insurance, taxes, family maintenance, and education, could not be reduced. Although in a year or two after their return it may be hoped those affected will recover their position, still in the interval help is, and will be, necessary, and it is to meet these needs that the War Emergency Fund was established. To be effective the grants must be made on a liberal scale, and the fund from which they are to be drawn must be a large one. The sum obtained last year was about £4,000. This is quite inadequate, as at least £25,000 will be required, if even a small proportion of those requiring assistance is to be helped. From the wealthier members of the medical profession, it is hoped, substantial sums will be received, but every one should feel it a duty which he owes to his less prosperous colleagues to give the most liberal donation he can afford.

At the same time the appeal is not, and ought not to be, restricted to the medical profession. The public, too, may be rightly called upon to bear its share, and to show, by liberal contributions, its appreciation of the special services so freely rendered by the medical profession to the country.

The War Emergency Fund is a special department of the Royal Medical Benevolent Fund. It is kept separate and distinct from the ordinary operations of the general fund, and is under the management of a committee specially appointed for the purpose.

Communications should be addressed to the Honorary Secretary, War Emergency Fund, 11, Chandos Street, Cavendish Square, W.1., to whom cheques should be made payable.

We are, etc.,

Samuel West, *President.*

Charters J. Symonds, Colonel A.M.S.,
Honorary Treasurer.

G. Newton Pitt, Major R.A.M.C.(T.),
Honorary Secretary.

London, W.1, June 8th.

Cases of Special Distress caused by the War which the Committee have Helped.

A lieutenant in the R.A.M.C., who had only been in practice a few years, volunteered for service, and was killed in action a few days later. He left a widow, with two children, aged 3½ and 1 year, without means except the War Office pension. The Fund voted £25 for her immediate necessities, and the Officers' Families Fund gave further help.

A captain in the Territorials was called out, and had to leave his practice in the hands of a locum, who proved a failure. There were seven children aged 2 to 14. Financial difficulties arose, and payment of the school fees became impossible. Between the Fund and Guild, and the Officers' Families Fund, the necessary fees were raised, and sorely needed clothing provided.

A captain in the Territorials, who was called out when the army mobilized, and had to leave his practice worth £800 at a day's notice, could not pay the fees for his son's education, who was in his last year at school. The Fund, the Guild, and the Professional Classes War Relief Council together raised the necessary money.

A captain in the Territorials was killed in action, and left a widow, and two children, aged 3 and 4½ years. The Fund investigated the case, and referred it to the Officers' Families Fund, who gave her a grant to meet her immediate necessities. The Fund also obtained work for the widow, a trained nurse, who was thus enabled to earn her own living.

A major, R.A.M.C., Territorial, was called out at the beginning of the war and was abroad for over two years. He was invalided to England and put on home service. His practice was completely lost by his absence. There are three children, one in the navy, one in the army, and one at school. He had to give up his house, as he was in difficulties with rent, taxes, and education. The Fund gave £50, and further help was obtained from other sources.

A captain in the R.A.M.C.(T.), with a wife and six children, found the income derived from his practice, left in charge of a locum, and the balance of his army pay insufficient to meet his expenses. He obtained assistance from the Civil Liabilities Committee and the Officers' Families Fund, and a grant was made from the War Emergency Fund towards the education of the children.

A practitoner, earning £700 to £800, volunteered for service, leaving his practice in the hands of a neighbour, who was not a success. There were two children, aged 7 and 10, and another baby was born shortly after the husband left. The wife contracted pneumonia and nearly died. A resident patient had to leave the house. Rent and other expenses led to a debt of about £80. This the doctor could not meet, and he hurried back from the trenches to save his home from being sold up. The Fund voted £25, the Guild gave £15, the Officers' Families Fund £25, and the Professional Classes War Relief Council offered further help, with the result that he returned to the front with his immediate anxieties relieved.

Sirs,—We beg to support the urgent letter of appeal to this Fund which appeared in the last week's medical journals.

This Fund was instituted by the Royal Medical Benevolent Fund last year to afford assistance to members of the profession who, in consequence of having joined the Army Medical Service, find themselves in temporary difficulties.

We very strongly commend the claims of this Fund to the generous support of both the profession and the public.

We are, etc.,

Frederick Taylor
(*President, Royal Coll. of Physicians*).

W. Watson Cheyne
(*President, Royal College of Surgeons*).

W. H. Norman, Surgeon-General, R.N.
(*Director-General of the Medical Dept. of the Navy*).

Alfred H. Keogh
(*Director-Gen. Army Medical Service*).

William Osler
(*Regius Professor of Medicine, University of Oxford*).

T. Clifford Allbutt
(*Regius Professor of Physic, University of Cambridge*).

John Tweedy
(*Past-President, Royal Medical Benevolent Fund*).

11, Chandos Street, Cavendish
Square, W.1, June 16th.

PUBLICATIONS RECEIVED.

Books.

Electrotherapy in Gynæcology. By S. Sloan, M.D., F.R.F.P.S.G. [Wm. Heinemann (Medical Books) Ltd.].

Photo-Electricity. By H. S. Allen. (Longmans, Green & Co.).

Journals.

American Journal of Electrotherapeutics and Radiology, June, 1917.

American Journal of Roentgenology, June, 1917.

American Medicine, May, June, 1917.

Archives de Médecine et de Pharmacie Militaires, March, 1917.

Boston Medical and Surgical Journal, May 31st, June 7th, 21st, July 5th, 1917.

British Journal of Surgery, July, 1917.

Cleveland Medical Journal, May, June, 1917.

España Oftalmologica, May, 1917.

Gaceta Médica Catalana, June 30th, July 15th, 1917.

Journals—*continued.*

Good Health, June,1917.

Hospitalstidende, July 4th, 1917.

Interstate Medical Journal, June, 1917.

Johns Hopkins Hospital Bulletin, July, 1917.

Maryland Medical Journal, July, 1917.

Medical Journal of Australia, May 19th, 26th, 1917.

New York Medical Journal, June 2nd, 9th, 16th, 23rd, 30th, 1917.

New York State Journal of Medicine, June, 1917.

Norsk Magazin for Lægevidenskaben, June, July, 1917.

Pacific Medical Journal, July, 1917.

Policlinico, Il., June 15th, July 1st, 1917.

Revista Espanola de Electrologia y Radiologia Medicas, April, May, June, 1917.

Proceedings of the Royal Society of Medicine, June, 1917.

Southern Medical Journal, June, 1917.

Ugeskrift for Læger, June 7th, 14th, 21st, July 8th, 1917.

NOTICES.

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Communications and illustrations from American contributors may be sent to Messrs. Rebman Company, 141-145, West Thirty-sixth Street, New York City.

All radiographs and photographs must be originals, and must not have been previously published. Drawings should be supplied on separate paper.

Owing to the scarcity of paper the Publishers are reluctantly compelled—as a temporary war measure—to reduce the number of free reprints of Papers to twenty-five.

Communications relating to advertisements should be addressed to the Publishers, Messrs. WM. HEINEMANN (Medical Books) Ltd., 20, Bedford Street, London, W.C. 2, Telegraphic Address: "Sunlocks, London"; Telephone: No. 5675 Gerrard, and (American) Messrs. REBMAN COMPANY, 141-145, West Thirty-sixth Street, New York City.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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SIDNEY RUSS, D.Sc., Physicist to the Middlesex Hospital.

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ROENTGENOLOGY OF THE OS PETROSUM.

By H. W. Stenvers.

Clinical Assistant Radiologist, Clinic of Psychiatry and Neurology at the University of Utrecht (Holland), Prof. C. Winkler, Dir.

The common occipito-frontal and bi-temporal radiographs not usually giving a clear picture as far as the os petrosum is concerned, I have endeavoured to project the os petrosum in such a manner as to make this possible, and to indicate the clinical value of the method.

In order to obtain this it is necessary to try to produce a picture of the os petrosum with constant lines and figures, each having their unquestionable significance.

Searching after the proper manner of projection, I have always kept in mind the following principles, already partly formulated by Schüller, namely:—

1. Each part of the skull that we are to examine should appear on the plate, as little as possible covered by confusing lines.

2. The patient has to assume, therefore, a comfortable position. Patients severely ill should be able to assume such a position.

3. The value of the lines and shadows must be critically examined. This might be done in the following ways:—

   (*a*) By covering with lead the parts that probably cause the lines, the result being that on the picture the lines are covered by a heavy shadow.

   (*b*) By eliminating the parts causing those lines. In the radiograph, taken in this way, the mentioned lines will not be noticeable.

   (*c*) By filling up with lead the cavities, which project themselves like distinctly outlined spots.

The latter way will, as a matter of fact, play an important part in the demonstration of the os petrosum, where we have principally to deal with cavities.

Method of Radiographing the Os Petrosum.—The os petrosum should be lighted through in such a manner as to make it impossible for confusing lines, which render the picture indistinct, to obliterate essential details.

To this end it should be projected on the frontal part of the pertaining squama of the os temporale with the adjacent parts of the os sphenoidale. It is, however, not sufficient that only the os petrosum appears on the plate as much as possible uncovered. None of the various parts should cover each other, or, at any rate, as little as possible.

The parts that belong to the os petrosum are: the porus acusticus internus, the ductus semicirculares, the vestibulum, the cochlea, and the mid-ear.

In order to be able to expose these composed parts roentgenologically it is necessary to form an idea of the place and structure of the os petrosum.

The os petrosum (Fig. 1 R) is situated on the edge of the middle and hindmost skull-grove, and runs from latero-posterior to medio-anterior direction.

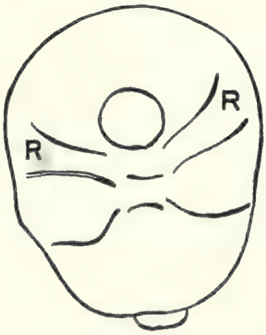


Fig. 1.

In Fig. 2 we notice the os petrosum reproduced with the cochlea and the ductus semicirculares pictured therein. They are lying side by side, about parallel with the axis of the os petrosum. The level being brought through the basic winding of the cochlea, runs parallel to the level which runs through the hindmost vertical ductus semicircularis. A horizontal line, parallel to this level, makes an angle of 45 degrees with the mid-line of the skull.

On Fig. 2 it is illustrated that the level which runs through the basic winding of the cochlea is, at the same time, the level wherein the complex of ductus semicirculares might be projected next to the cochlea.

This favourable circumstance shows consequently which direction of rays should be chosen, namely, that which stands perpendicularly on the level wherein the basic winding of the cochlea lies.

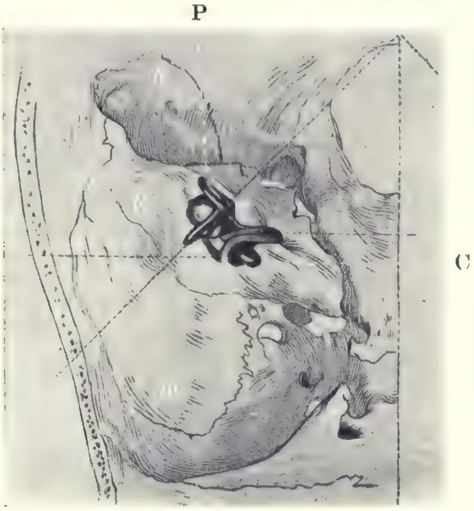


Fig. 2.

m = Middle skull-grove.
h = Hindmost skull-grove.
P = Hindmost vertical ductus semicircularis.
C = Cochlea.

(From Spalteholz.)

As already stated, this level makes an angle of 45 degrees with the midline of the skull. The most distinct and less transformed pictures are obtained by bringing also the projection level parallel to the level through the basic winding, or, which is the same, by bringing the latter parallel to the former. The photographic plate, which is placed on the table (lying horizontally) serves as the projection level. Now, by placing the skull in this way on the cassette, causing the sagittal axis to become parallel to the cassette, the level of the basic winding of the cochlea makes an angle of 45 degrees with the horizontal level (Fig. 3).

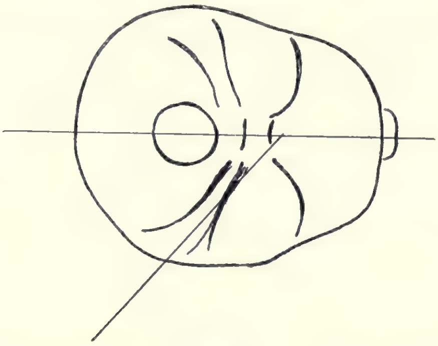


Fig. 3.

By turning the skull over on its vertical axis, with the nose-chin-line downwards, over an angle of 45 degrees, the level of the basic winding becomes horizontal (Figs. 4*a* and 4*b*).

The rays should, therefore, fall in a perpendicular direction thereon, that is to say, in a vertical direction.

Should we take, however, the central ray absolutely vertically, the mid-ear and the ductus semicirculares should for a very large part be projected one upon the other, because the mid-ear lies in front of and inferiorly to the ductus semicirculares. The best way to obtain a general view of the relation between the mid-ear and the ductus semicirculares is to make an intersection through the os petrosum perpendicularly on the long axis.

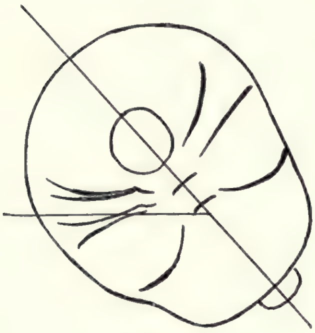


Fig. 4*a*.

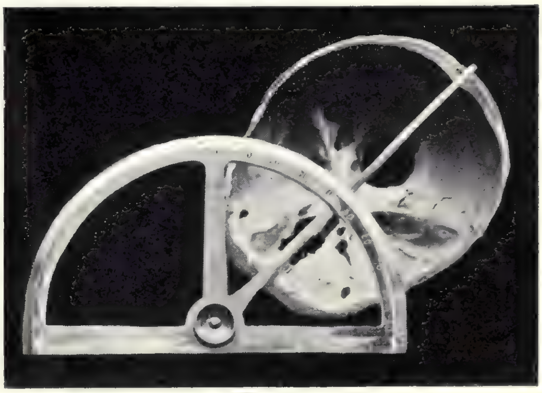


Fig. 4*b*.

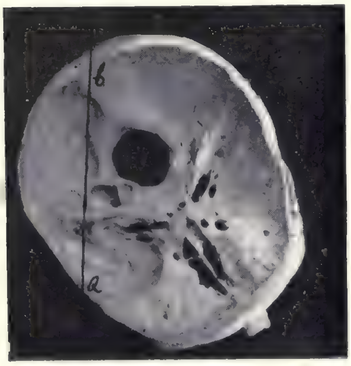


Fig. 5.

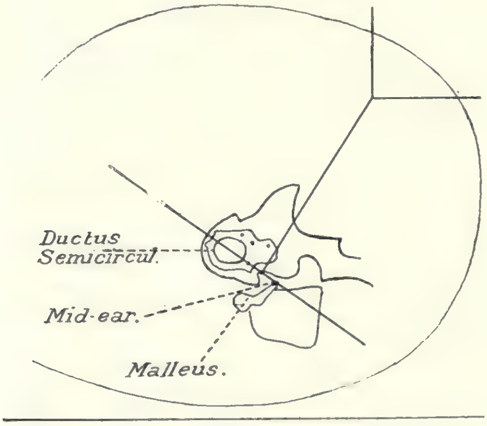


Fig. 6.

Fig. 6 shows the very schematical picture. The os petrosum is presumed to be in a position as described above (see Fig. 5), the sagittal axis making an angle of 45 degrees with the horizontal line. The line *a*, *b*, in Fig. 5, shows the level wherein the intersection through the skull is made.

Examining this intersection (Fig. 6) we notice two large complexes—the ductus semicirculares and the mid-ear. Both parts are situated in a different level with respect to the bottom layer. They cover each other for a large portion in their horizontal projection.

It is now necessary to project side by side two objects, having a certain circumference and lying in a different level with respect to the fixed projection level, in such a manner as to ensure their covering each other as little as possible.

To attain this aim the projection rays should be directed so as to cause them to run through a level, perpendicular on the line, which goes through the centre of those objects. (See Fig. 7.)

A and B present the objects to be projected. Without involving ourselves in mathematical problems we notice that the parts, covering each other in the projection, are the smallest by the direction of rays 1 A_1 B_1 A_2 B_2 A_3 B_3.

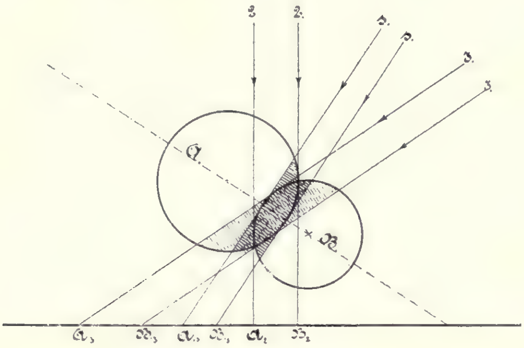


Fig. 7.

Applying to the sketch in Fig. 6 we find that we now can determine the required direction of rays.

We connect the centre of the mid-ear and ductus semicirculares with each other, and take care that the direction of rays is selected from a level situated as much as possible perpendicular on this line.

The correct angle of this desired direction is not known to me. However, in Fig. 6 it is illustrated that the rays should fall from the top distally to the bottom proximally. On account of the above-mentioned fact, I have arrived at the conclusion that for the roentgenology of the os petrosum the following technicalities are indispensable :—

(*a*) The skull should be placed on the cassette in such a way as to compel the sagittal axis to make an angle of 45 degrees with the horizontal line.

(*b*) The direction of rays should be such that the central ray runs in a vertical level (see Fig. 5), while the tube inclines distally. The angle I have chosen for the inclination of the tube is 12 degrees. Practical reasons have led me to make the angle not more than 12 degrees. If it is desired to obtain a specially good picture of the mid-ear it is easy to incline the head with the proximal end downwards.

Radiographs of the os petrosum taken in this manner, largely on account of the distance of the tube from the plate and the width of the diaphragm, are very unsatisfactory.

This is accounted for by two reasons, namely, (1) because the roentgen rays do not run sufficiently parallel, which causes the already delicate picture to fade away ; (2) because of secondary radiation.

In endeavouring to obtain as many parallel rays as possible, I placed the tube further from the object, and had the usually employed blend of Albers-Schönberg lengthened with a similar piece. To avoid secondary radiation, I fixed replaceable diaphragms of lead in the blend, so that only the desired os petrosum was fully irradiated. These diaphragms also served to obtain more parallel rays.

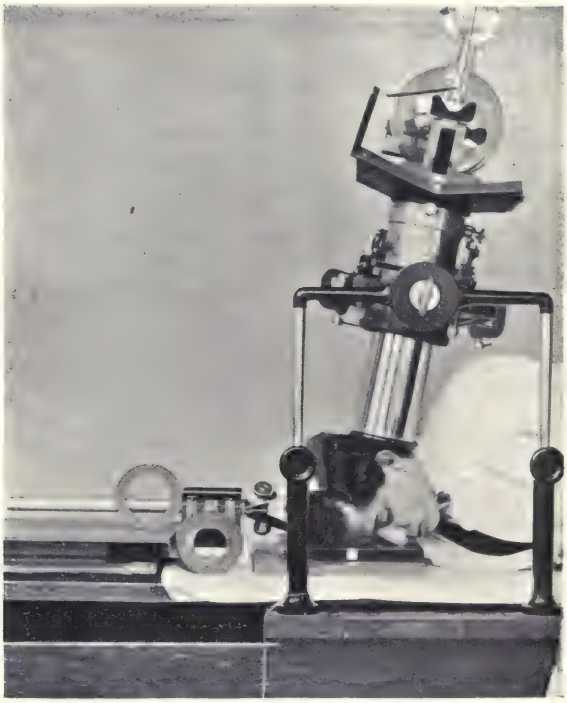


Fig. 8.

The inserted photographs (Figs. 8, 9 and 10) clearly show the alterations on the roentgen apparatus, and the way of manipulating the same. It goes without saying that the apparatus should be started in very accurately, and that it is necessary to continually make pictures of both ossa petrosa in exactly the same position in order to compare them.

Description of the Picture taken.—We commence to place the skull in the required position with the aid of the cross-staff (as shown in Fig. 10). The hand of the cross-staff is set on 45 degrees, and thereupon the line from the sutura naso-frontalis to the protuberantia occipitalis (sagittal axis) directed parallelly thereon. In this position the head is fixed in a scrape. Now the tube is started in, mounted with the lengthened pipe attached, so that the central ray goes according to the line in Fig. 5, that is, vertically and through the labyrinth.

I therefore place my finger on the processus mastoidens of the os petrosum, which is to be radiographed, and start in on a point situated to the side of the nose, a few centimetres from my finger. Now the pipe and tube are turned over distally in a vertical level over an angle of 12 degrees, while now again, by removing the pipe and tube entirely distalward, we start in on the processus mastoidens.

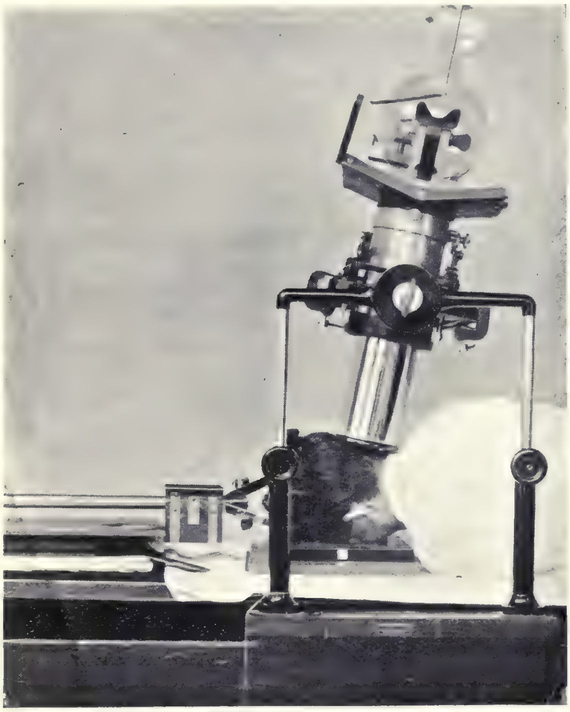


Fig. 9.

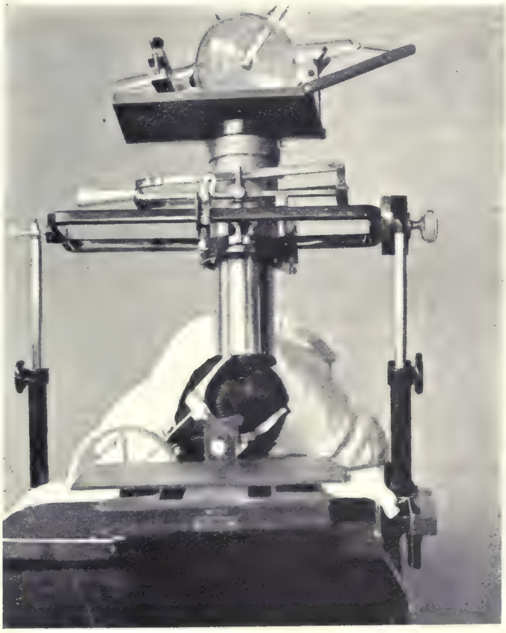


Fig. 10.

The tubes should be a trifle harder than the ones used for a bitemporal skull radiograph. The time for exposure is about one-third longer than necessary for bitemporal radiographs. The result is, that on radiographs thusly made, all parts of the os petrosum are plainly visible. First of all I will speak about the radiogram of the skeleton skull.

Following (Fig. 11) the upper edge of the os petrosum we distinguish, about in the middle, a white spot, the diameter of the foremost vertical ductus semicircularis. From this point the ductus semicircularis runs, lightly curved, downwards, finally ending in the wide vestibulum. From the vestibulum we notice lateralward a white line, the horizontal ductus semicircularis. Around the horizontal ductus semicircularis runs, nearly circularly and vaguely, the hindmost ductus semicircularis. Now, going from the vestibulum downwards and a trifle medialwards, we arrive in the cochlea, which projects itself in the form of a rolled-up ribbon.

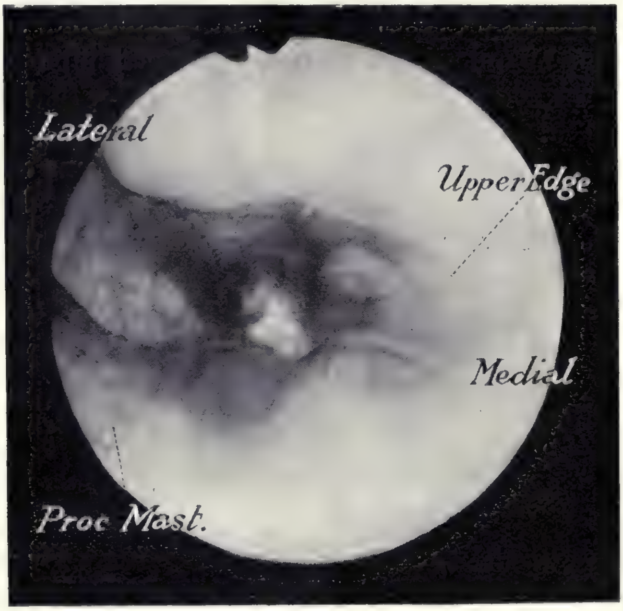


Fig. 11.

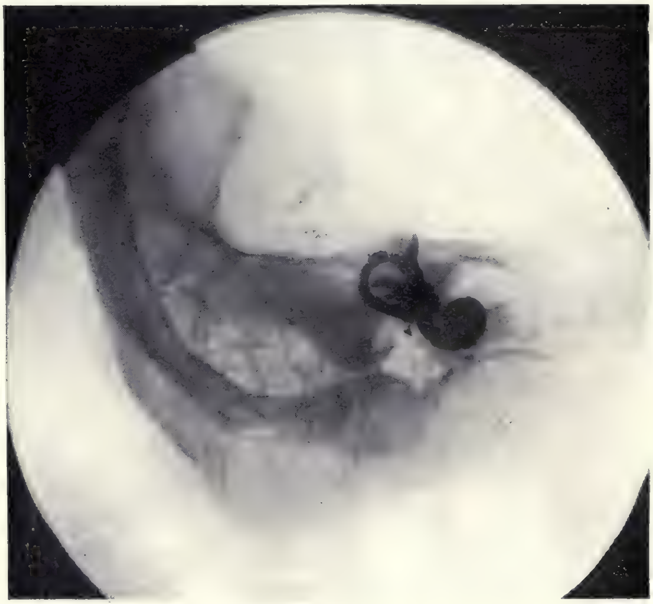


Fig. 12.

Comparing Fig. 11 with Fig. 12 the above described picture will become very clear. In Fig. 12 we see the os petrosum projected wherein the ductus semicirculares and the cochlea are filled up with lead. It is even noticeable that, to that end, the os petrosum has been sawed in different pieces. Both pictures are plainly recognisable. The porus acusticus internus partly covers the cochlea.

Naturally the radiograph of the intact skull of the living being renders less distinct pictures, while this requires our help with the intensifying screen. Nevertheless, the picture taken, *in vivo*, renders a very satisfactory result.

On Fig. 13 we notice a representation of a picture of the same os petrosum, taken, *in vivo*, which on Fig. 11 is projected in skeleton form. Only, the drawing is reversed on account of the different position of the plate by using the intensifying screen. Nevertheless, by searching in the way as described above, we shall easily find all the ductus semicirculares and the cochlea.

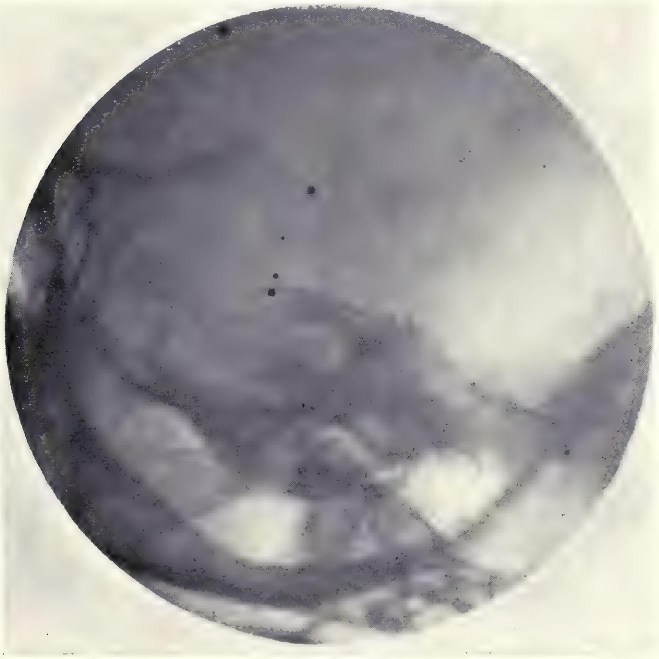


Fig. 13.

On Figs. 22 and 23 also normal pictures of the os petrosum, *in vivo*, are demonstrated.

Now some remarks about the situation of the cavum tympani.

To ascertain this fact I filled the cavum tympani with lead paste, that is to say as far as such was possible with the intact skeleton skull. Thereafter, I filled the external meatus acusticus with wax and barred the porus acusticus externus with lead.

On Fig. 14 we see that the lead of the cavum tympani projects itself underneath the cochlea and vestibulum in the white spot which is visible there (Fig. 11).

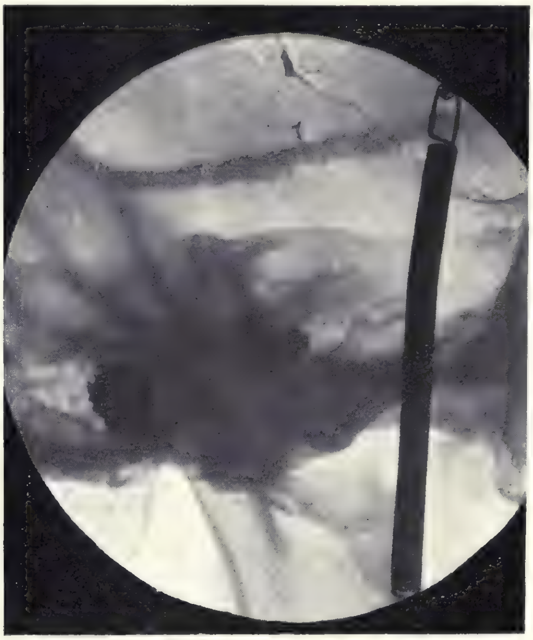


Fig. 14.

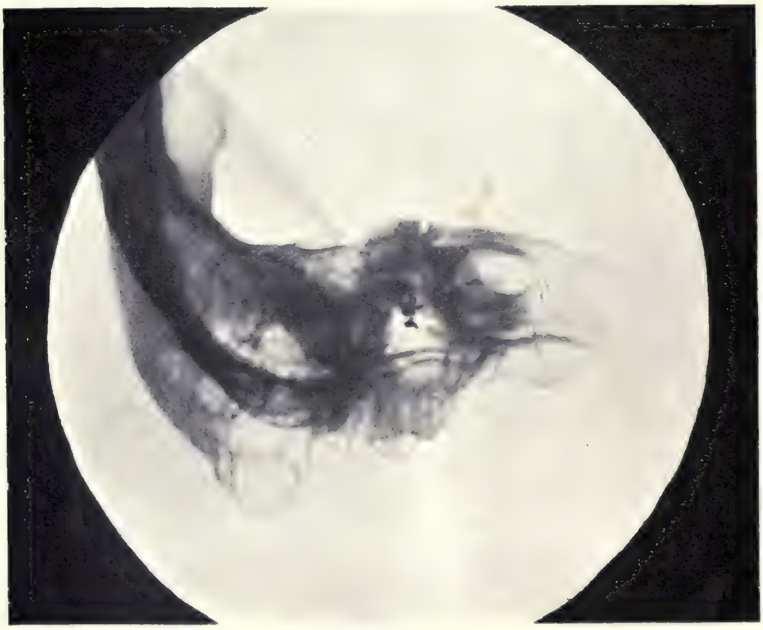


Fig. 15.

Evidently the filling of the cavum tympani has not been complete. I succeeded in covering the auditory ossicles with lead, and by preparing the radiograph, it became apparent that the ossicula auditivus projected themselves a great deal underneath the horizontal ductus semicircularis. To get the cavum tympani distinctly projected it is necessary that the head pends rather strongly downwards (about 10 degrees) when the picture is taken.

On Fig. 15 we contemplate the auditory ossicles. Evidently the cavum tympani corresponds to the *entire* white spot, which is to be seen underneath the cochlea, and the ductus semicirculares. We have to consider, by the projection of the auditory ossicles covered with lead, that it was necessary to open the cavum tympani and that the membrana tympani had to be partly deprived of its attachment. The place of the auditory ossicles shall, therefore, not answer to its natural situation.

In order to ascertain the situation of the auditory ossicles in their normal relations in the radiograph I went to work in the following way:—

I removed a small portion of the top of the recessus epitympanicus of a normal os petrosum, just sufficiently to remove with a very fine pincet the auditory ossicles. Thereafter the following stereoradiographs of this os petrosum have been made :

(*a*) With the auditory ossicles being entirely intact (Fig. 16 *a*).

(*b*) After removal of the incus (Fig. 16 *b*).

(*c*) After removal of the malleus and the incus (Fig. 16 *c*).

(*d*) After removal of malleus, incus and stapes (Fig. 16 *d*).

In this series of stereoscopical radiographs the entire experiment may be followed.

On Fig. 16 *a*, the malleus, of which the head has been partly covered with lead, is plainly visible.

To simplify the orientation and the explanation of the radiographs I shall point out a few fixed spots in and around the mid-ear. (See the schematical illustration of Fig. 16 *a*.)

The vestibulum and the tube of the cochlea are recognisable as such. More lateralwards a dark curve is projected, the significance of which I do not know yet, though I shall call it "curve *x*."

The handle of the malleus, on Fig. 16 *a*, crosses the curve *x* exactly at its lowest point. The head, covered with lead, extends between both arms of the curve like a chord in the direction of the vestibulum.

About at the neck of the malleus the incus appears with its joint surface directed towards the head of the malleus.

Two little patches of the stapes are noticeable.

On Fig. 16 *b* the incus has disappeared. The malleus is, although less plain, still visible, while of the stapes perhaps something is to be seen.

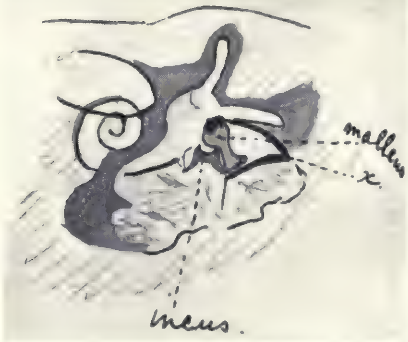
Fig. 16 *c* reproduces very clearly the stapes. Now the malleus and the incus have disappeared. Two little patches on the edge of the tube of the cochlea reproduce the corner points of the legs and the plate of the stapes, which is seen to put out downwards into the cavum tympani.

Fig. 16 *a*.

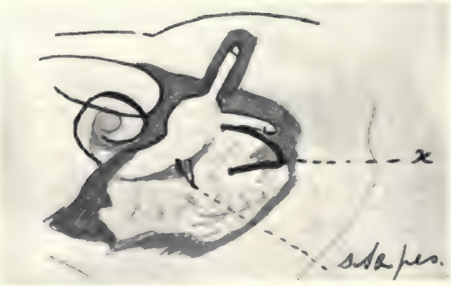
Fig. 16 *o*.

Fig. 16 *c*.

Fig. 16 *d*.



Schematical Illustration of Fig. 16 *a* (right part).



Schematical Illustration of Fig. 16 *c*.

On Fig. 16 *d* the entire cavum tympani is empty. Sometimes also in radiographs taken of the living being, when the inclination of the skull is rightly chosen, the auditory ossicles are recognizable. The porus acusticus externus projects itself (Fig. 14) medio-frontally from the base of the mastoid. On Fig. 15 we discover at that place a light spot, which runs medialwards into a broad channel to finish in the cavum tympani. In the radiographs taken *in vivo* this complex is sometimes very sharply, but not constantly, outlined. Constant and clinically, of considerably greater significance is the porus acusticus internus. We detect medially from the vestibulum a sharply outlined elliptical figure, partly covering the cochlea. In this figure a still whiter spot is visible.

On Fig. 17 we see a radiograph of a skull wherein the porus acusticus internus is covered with lead, while the meatus acusticus internus is filled with wax. We notice that the lead mass falls exactly on the spot where the white spot is situated.

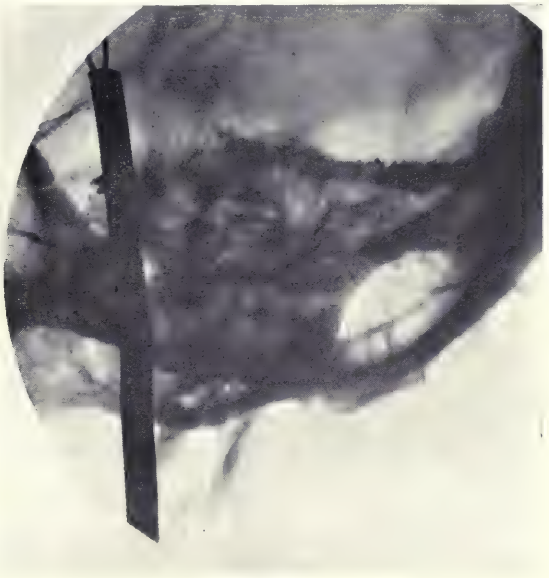


Fig. 17.

The white spot within the elliptical edge represents the porus, and the edge itself the enclosure of the meatus acusticus internus. The value that the roentgenological treatment of the os petrosum *in vivo* shall have for the anatomist, the physiologist, and the pathologist-anatomist has yet to be proved. Clinically, it is of scientific as well as of practical importance.

I desire to demonstrate this with a few examples, but shall only describe in short the clinical particulars, as those are more advantageously dealt with elsewhere.

Examples.—I. The first case represents a left side acusticus tumour, that with the aid of radiographs is very promptly diagnosed.

On Fig. 18 ductus semicirculares and cochlea are very distinct. The strongly widened porus acusticus internus extends over the cochlea.

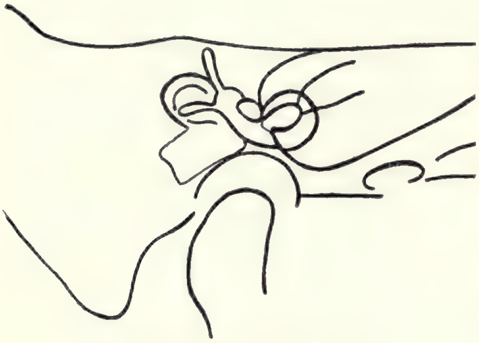


Fig. 18 (Outline drawing).

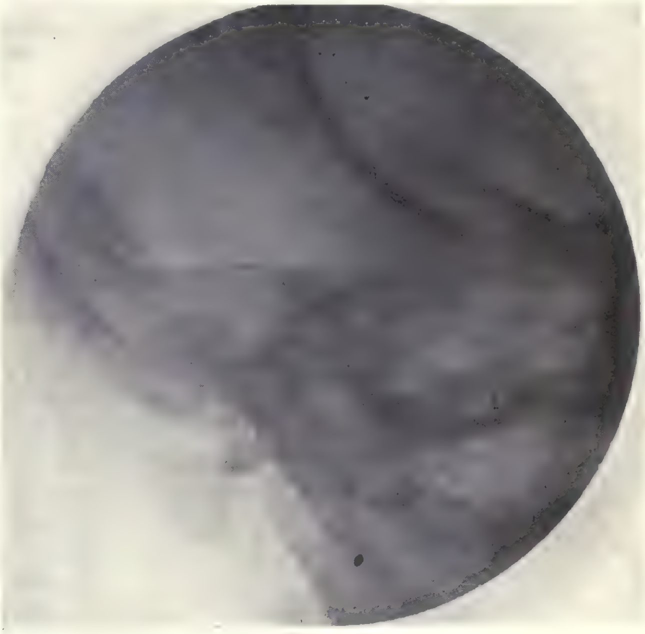


Fig. 18.

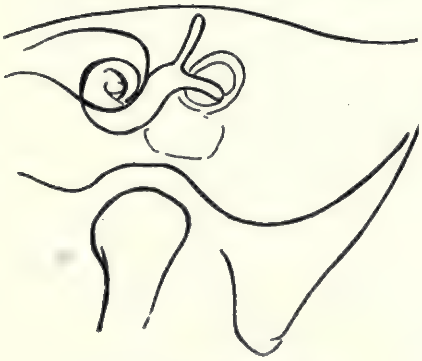


Fig. 19 (Outline drawing).

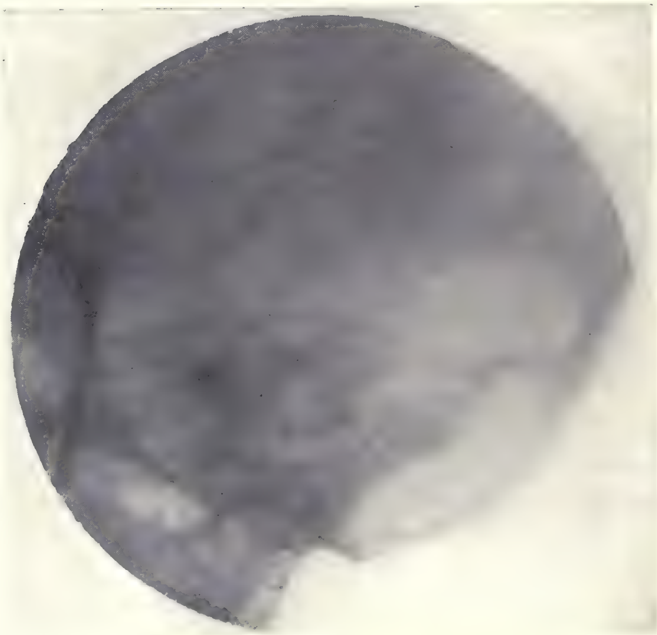


Fig. 19.

The difference when compared with the sound side (Fig. 19) is quite evident.

The autopsy absolutely confirmed the radiograph.

II. The second case treats of a fracture of the os petrosum through the ductus semicirculares, which needs no further explanation ; it is quite visible (Figs. 20 and 21). Otological diagnosis in this case confirmed the radiograph.

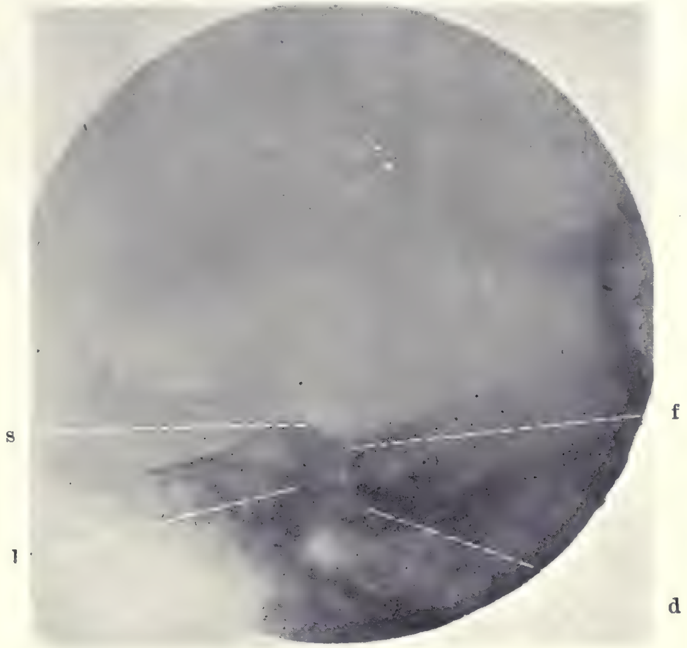


Fig. 20.

s = duct. semicircul. sup.
l = duct. semicircul. lat.
d = duct. cochleæ.
f = fracture.

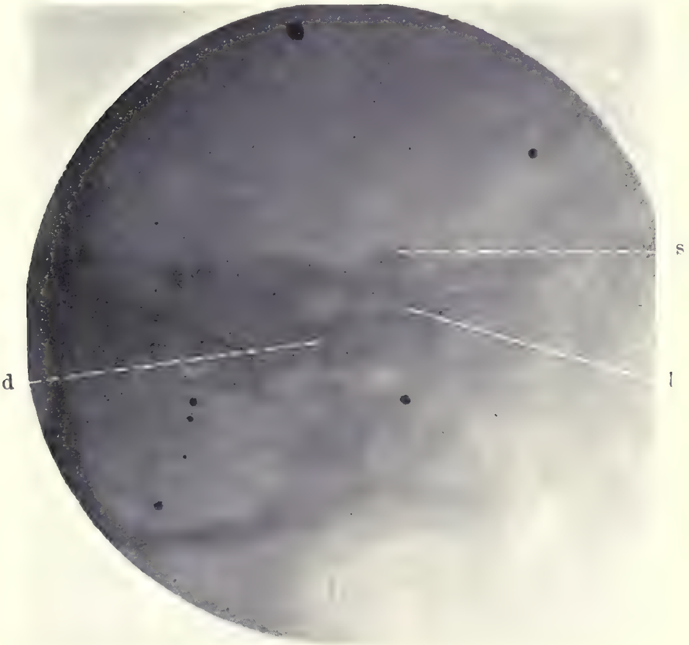


Fig. 21.

s = duct. semicircul. sup.
l = duct. semicircul. lat.
d = duct. cochleæ.

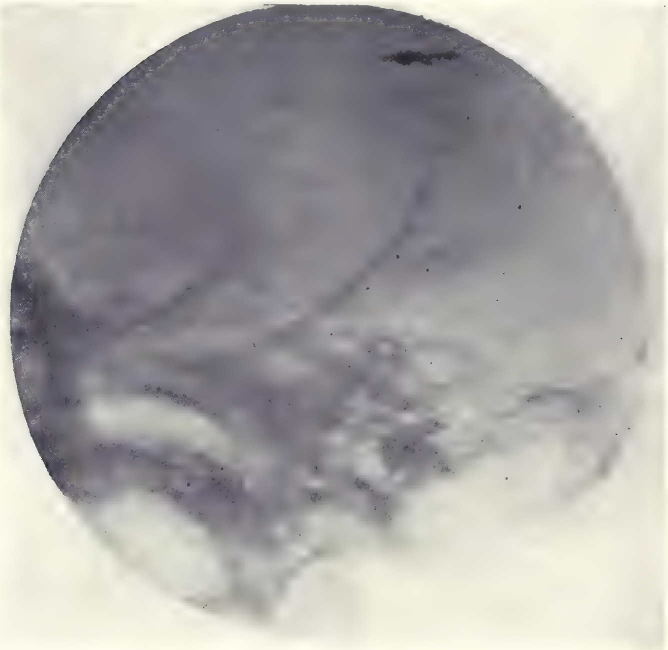


Fig. 22.

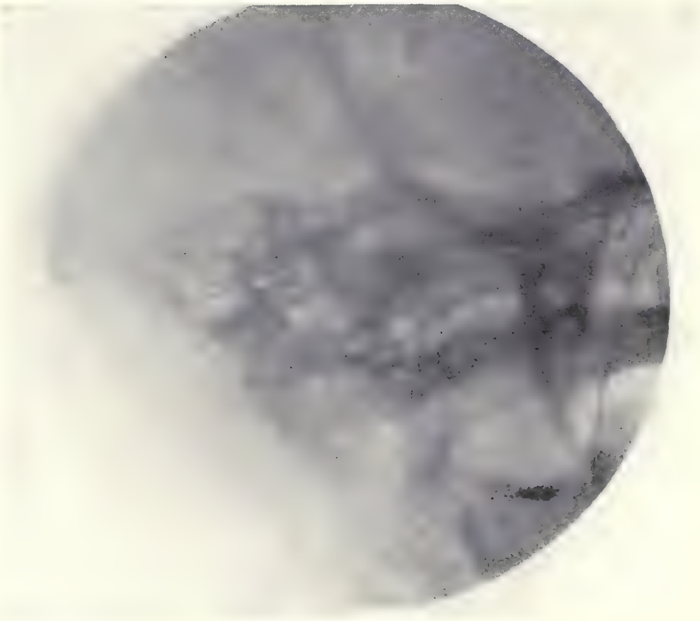
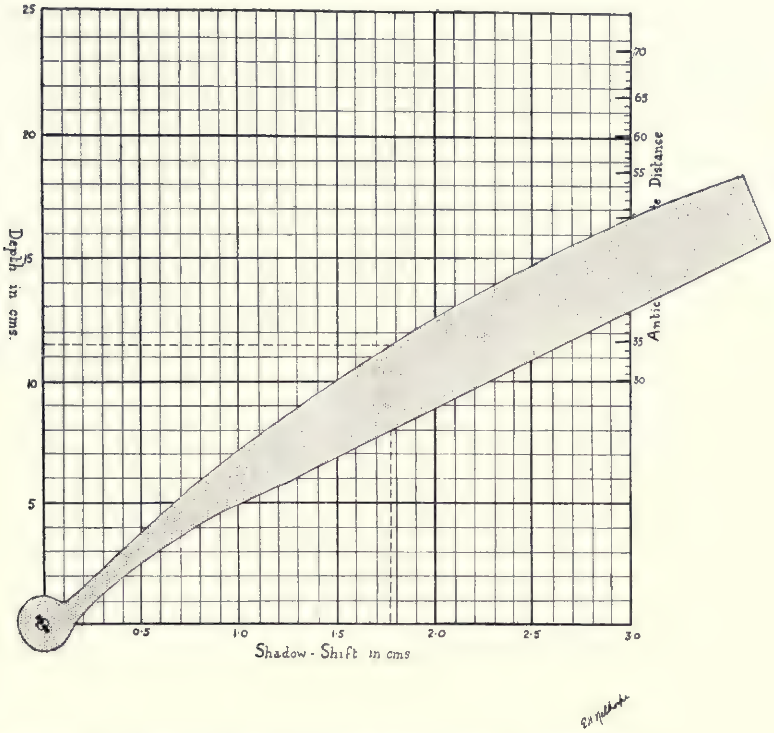


Fig. 23.

DESCRIPTION OF A METHOD FOR THE RAPID DETERMINATION OF THE DEPTH OF FOREIGN BODIES FROM X-RAY PLATES.

By E. H. Nelthorpe, B.Sc. (London), A.R.C.Sc., D.I.C. (London).

A number of methods have been devised, from time to time, for obtaining the depths of foreign bodies from the shift of its shadow on two plates taken with the X-ray tube in different positions. The actual path of the rays may be reproduced by threads, as in Sir James Mackenzie-Davidson's method, or the depth may be calculated by the use of a formula. Such methods take a considerable time, which often cannot be spared, especially in busy times with the Medical Services with the B.E.F., or in cases when very urgent operations are necessary. In order to make the determination of depth more rapidly, a slide rule may be used, but many persons not acquainted with such an instrument have difficulty in using it.



To find the depth of a Foreign Body (Tube-Shift = 0·6 cm.):— Set the arm so that the upper edge cuts the right-hand vertical line at the mark corresponding to the anticathode-plate distance used; find the vertical line corresponding with the measured shadow-shift; the point at which the horizontal line, set off from the point in which this cuts the upper edge, meets the left hand vertical line, gives the depth.

It therefore appeared that if an instrument could be devised, by means of which an accurate and rapid determination of depth could be made, and which could be used by anybody with no mathematical training, it would be of some utility. With the instrument about to be described, not only is it possible to obtain the required depth in a second or two, but it requires no special knowledge whatever in its use. Its construction depends on the assumption that the X-ray tube is always shifted by the same amount, but the distance of the plate from the anticathode may be anything within the workable limits.

Description of Instrument.—The instrument consists of a piece of cardboard ruled with squares. The vertical axis of co-ordinates is graduated to a scale of depths up to 25 cms. The scale chosen is $\frac{1}{4}$ in. to 1 cm. The horizontal axis is graduated to represent the shift of the shadow of the foreign body to scale, the scale chosen being 1 in. to 0·5 cms. An arm, preferably of thin metal, is made to rotate within the required limits about the intersection of the axes. The upper edge of this arm is made to take the shape of a definite curve, described below. The vertical line, corresponding to a shadow-shift of 3 cms., is graduated with a scale of anticathode plate distances.

Method of Using Instrument.—The arm is rotated until the upper edge cuts the right hand vertical line at the mark corresponding to the anticathode plate distance used. The point in which the measured shadow-shift ordinate cuts the upper edge of the arm is found and the corresponding depth read off on the vertical axis.

Theory of the Instrument and Method of Obtaining the Curve.—If y be the depth of the foreign body from the plate, x the shadow-shift, t the constant tube-shift, and h the anticathode plate distance, the relation between the quantities is expressed by:—

$$y=\left(\frac{x}{x+t}\quad h\right)$$

The curve plotted between x and y, with h and t constant is a hyperbola passing through the origin of co-ordinates. Whatever be the value of h, the curve must always pass through the origin, because zero shadow-shift always means zero depth. It may also be noticed that with a constant shadow-shift change of depth is proportional to change of anticathode plate distance, for the expression in the bracket remains constant. By rotating the hyperbola about the origin, within the limits of the diagram, and for all practical purposes the change in y along any shadow-shift ordinate is proportional to the change in h.

In order to give the upper edge of the arm the necessary shape the following is the procedure. A piece of paper is ruled with squares to the scales suggested above. The curve is next drawn for some particular anticathode plate distance. A suitable set of numbers which may be plotted are those for an anticathode-plate distance of 50 cms., as follows:—

Shadow-shift -	0·2	0·4	0·6	0·8	1	1·2	1·4	1·6	1·8
Depth - -	1·6	3·1	4·5	5·9	7·1	8·3	9·5	10·5	11·6

Shadow-shift ·	2	2·2	2·4	2·6	2·8	3
Depth - -	12·5	13·5	14·3	15·2	15·9	16·7

The curve is cut out of the paper, which is then pasted to the sheet of metal, and thus serves as a guide to the shape of the upper edge. The breadth of the arm should not be made too great, as it is not wise to hide more of the squares than necessary. The end of the arm about which it rotates is finished off with a circular disc about ½ in. in diameter, and a small hole made in it at the point which corresponds to the intersection of the axes. The arm may be conveniently mounted on the cardboard with a small copper rivet.

The divisions for the anticathode plate distance on the 3 cm. shadow-shift ordinate are, of course, obtained by finding the depths corresponding to various distances with the constant shadow-shift, of 3·0 cms. These are:—

Anticathode Plate Distance	30	35	40	45	50	55	60	65	70
Depth - - - -	10·0	11·7	13·4	15·0	16·7	18·4	20·0	21·6	23·4

Example.—As an example, let the anticathode plate distance used be 50 cms., and the measured shadow-shift 17¾ millimetres. The arm is set as shown in the diagram. The vertical line corresponding to 1·77 cm. is found, and where this cuts the upper edge of the arm, the horizontal line gives the depth required as 11·5 cms., as shown in the diagram.

Note on a Simple Method of Estimating the Depth of a Foreign Body, Designed by Pte. Nelthorpe, R.A.M.C.

By J. W. West, Major R.A.M.C., Officer-in-Charge, Surg. Division, No. 13 General Hospital.

In order to test the accuracy and utility of the method invented by Pte. Nelthorpe for estimating the depth of foreign bodies, as described in his paper, I have used the method in a series of cases.

In each case as a control, the depth of the missile has also been worked out by the slide rule.

In my opinion it is much easier and quicker to use this chart than to use the slide rule, and a novice, by following out the instructions on the chart, should be able to measure the correct depth of a foreign body with an error of not more than a millimetre, and this from a surgical standpoint would be unimportant.

The following six cases in which it was used show its accuracy within the limits stated :—

Plate No. 7657.

No. 3939, Pte. W.
G. S. W. Head. Piece of metal in brain.
Shadow-shift 0·6 cm. Anticathode plate distance 62 cm.
Depth of foreign body from side of head :—

By Nelthorpe's Chart	5·5 cm.
By Slide Rule	5·4 cm.

Plate No. 7735.

No. 4996, Cpl. D.
G. S. W. Back. Piece of metal in chest.
Shadow-shift 0·7 cm. Anticathode plate distance 62 cm.
Depth of foreign body from back:—
By Nelthorpe's Chart 6·5 cm.
By Slide Rule 6·5 cm.

Plate No. 7734.

No. 21340, Pte. S.
G. S. W. L. Thigh. Piece of metal behind femur.
Shadow-shift 0·5 cm. Anticathode plate distance 58 cm.
Depth from back:—
By Nelthorpe's Chart 4·5 cm.
By Slide Rule 4·4 cm.

Plate No. 7771.

No. 4200, Pte. R.
G. S. W. Head. Piece of metal in brain.
Shadow-shift 0·2 cm. Anticathode plate distance 60 cm.
Depth of foreign body from side of head:—
By Nelthorpe's Chart 2 cm.
By Slide Rule 1·9 cm.

Plate No. 7778.

No. 265298, Pte. A.
G. S. W. Back. Lumbar Region.
Shadow-shift 1·5 cm. Anticathode plate distance 63 cm.
Depth of foreign body from back:—
By Nelthorpe's Chart 9·4 cm.
By Slide Rule 9.5 cm.

Plate No. 7779.

Spr. H.
G. S. W. L. Foot. Piece of metal in oscalsis.
Shadow-shift 0·2 cm. Anticathode plate distance 54 cm.
Depth from outer side of foot:—
By Nelthorpe's Chart 2 cm.
By Slide Rule 1·9 cm.

REPORTS OF SOCIETIES.

CONJOINT BOARD OF SCIENTIFIC SOCIETIES.

The fourth meeting of the Conjoint Board of Scientific Societies was held at the Royal Society on June 13th, Sir Joseph J. Thomson, O.M., Pres. R.S., in the Chair, to receive the report of the Executive Committee on the work of the previous six months.

As the report indicates, a number of important questions of scientific and industrial importance has occupied the attention of the Board.

Various bodies are at present interested in the formation of a census of the mineral resources of the Empire. It was agreed to enter into communication with these bodies and to make suggestions with a view to the publication of information in a form useful to the general community.

Interim reports were received and approved on the necessity for an anthropological survey of the British people, on the best methods for carrying on the International Catalogue of Scientific Literature, and on an enquiry into the desirability or otherwise of the adoption of the metric system throughout the British Isles.

The Sub-Committee on National Instruction in Technical Optics reported that a scheme approved by the Board of Education had now come into operation. Under the ægis of the Imperial College of Science and Technology an Advisory and Administrative Committee had been formed to organise instruction, and Mr. F. J. Cheshire, a member of the Sub-Committee of the Board, has been appointed Director of Studies in Technical Optics. Although the President of the Board of Education did not see his way to adopting the suggestions of the Sub-Committee, the Board heard with satisfaction that a promising effort has been made to solve a question of considerable national importance.

A Sub-Committee, having considered special cases of magnetic disturbances, revealed by a magnetic survey of the British Isles, and their possible connection with the occurrence of iron ores, recommended a detailed investigation of two test areas, in order to ascertain how far, under the conditions of the British iron ores, the magnetic survey was likely to prove of economic value. Arrangements for carrying out the investigation are in progress.

An Agricultural Sub-Committee, with the Earl of Portsmouth as Chairman, reported that it is at present devoting itself mainly to engineering questions. It is engaged in collecting information with regard to the transport of raw materials to farms and agricultural products from them, to the power required for this purpose, and for seasonal operations on the land, with a view to comparing the relative advantages and costs of steam or internal combustion engines and electrically operated machines. It is dealing also with the possibility of co-operation in repairs and skilled labour, and is considering the various types of tractor most suitable to large and chiefly arable farms and to moderate sized mixed farms, having regard to the different local circumstances and requirements.

A Sub-Committee was nominated to report on what is at present being done to ascertain the amount and distribution of water power in the British Empire.

A complete report of the first year's work of the Board will be published in due course.

RÖNTGEN SOCIETY.

The Future of the British X-Ray Industry.

At the meeting of the Röntgen Society, on April 3rd, a discussion took place on "The Future of the British X-ray Industry." It was opened by Mr. **Geoffrey Pearce**, who began by pointing out the large extent to which the British X-ray industry had suffered in the past from foreign competition. In 1912 and 1913 the total exports of electrical apparatus for medical and dental purposes from Germany amounted to £177,400 and £228,200 respectively, and the exports to the United Kingdom alone to £14,000 in the first year and about £19,000 in the second. It had been estimated that 50 per cent. of the apparatus used in this country was foreign, but in the absence of properly analysed trade returns, such figures were only guess work. This was due to a combination of circumstances. The foreign-made apparatus was not better so far as workmanship was concerned than could be produced at home, but new appliances had not, as a general rule, originated in this country, but elsewhere. We had, in fact, followed the lead of the Germans and others. Mr. Pearce instanced the alternating current high-tension transformer combined with a chemical or rotating rectifier; the heavy discharge induction coil with the large iron core and other modifications; the Coolidge and Lillenfeld tubes; and apparatus for single-flash exposures. German manufacturers had had opened up to them a very large field for the supply of X-ray and electro-medical apparatus, and had therefore been able to develop large concerns for production, and to employ highly trained technical staffs, not only to supervise production, but to carry out investigation and research. In this country the manufacturing houses had done their best to keep pace with the developments, but in the absence of properly trained and efficient technical staffs, they had, in many directions, although not entirely, fallen short of their foreign competitors. If British-made X-ray apparatus was to become pre-eminent and to capture the world's markets, research must be undertaken, but this was beyond the scope of the individual manufacturer, and ought to be part of a properly organised plan, the benefits of which would be enjoyed not only by the manufacturers themselves, but by the users of the apparatus. Another very important point was propaganda and publicity. A means should be found of attracting the attention of radiologists from all parts of the world to this country; not necessarily in the way of personal visits, although it would be extremely useful to have clinics with post-graduate courses of such reputation as would attract visitors from foreign countries, but much could be done in the way of literature. In conclusion, Mr. Pearce said that while an organisation of British manufacturers might do much to check and meet foreign competition at home, it was obvious to all that it was only by a participation in a large share of the world-wide trade that a sufficiently large output could be secured to enable the industry to be placed in the position it ought to occupy, and to develop as the scope of the science increased.

In the course of the discussion which followed, Professor A. W. **Porter**, F.R.S., said that research was a very difficult matter, and almost impossible in the case of small firms. The only solution was some sort of combination between different firms with this end in view. As to the necessary preliminary training of workers to equip them to carry out research in a works' laboratory, this was already available in, he thought, any physical laboratory in England. Of course, the actual final training of the researcher was a training which was outside what could be given in any academic institution, and could only be obtained in the works themselves. All the big firms in America were instituting research laboratories on a tremendous scale, as, for instance, the General Electric Company of America, and he saw no reason at all why such laboratories should not be instituted—perhaps on a smaller scale—if combination were effected between different firms.

Mr. R. S. **Wright** said that he had been doing his very best since he started in the business of a manufacturer of X-ray apparatus, in 1896, to manufacture and not to import, but, speaking broadly, the biggest obstacle to the carrying out of such a policy had not been the British manufacturer but the British medical man. British medical men had the rooted idea that a thing made in England must necessarily be behindhand. There was a feeling among British doctors that they must adopt everything that German doctors adopted, and that German methods must be best because they were German, and that if a British maker showed any originality the outcome of his enterprise must wait until Germany had endorsed it. On the other hand, the average German doctor had it firmly in his head that is was his business to keep German manufactures uppermost; he was as keen upon it as was the German manufacturer himself. He regarded it as a part of his definite personal responsibility. It was all *Deutschland über Alles.* Mr. Wright concluded by saying that if only the British users of apparatus were as anxious as they said they were to see the prosperity of British manufactures, and were willing to give some practical expression to their anxiety, perhaps even to the extent of a ten per cent. difference after the war, he would venture to say that in five years time they would not talk about British manufacturers being behindhand.

Dr. C. R. C. **Lyster** urged a combination of the medical man, the physicist, and the manufacturer—such a combination as the Röntgen Society afforded—to consider how best to help the British industry and to further the facilities for research.

Sir **James Mackenzie Davidson** said that he knew that in some cases an idea as to the superiority of German things appeared to obsess us. The German X-ray tube, it must be admitted, had had a superiority over those made elsewhere, but our American cousins—our allies now—had made a tube which would hold its own against any German tube or any other tube for many a day. He trusted that the goodwill between medical men and manufacturers after the war would tend to keep the manufacturers fully employed, and that their apparatus would be widely used. But they were not going to imitate the Germans and say that no one could produce anything worth while except themselves. They would probably go on buying apparatus from various sources after the war, though he did not think they would resume the buying of things German.

Capt. G. W. C. **Kaye** drew attention to the comparative weakness of British work on the applied side. In the sphere of pure physics, British work stood very high, but in practical applications we had not done a great amount of pioneering. What was wanted was a laboratory to which manufacturers could go with some assurance that their difficulties would be met and studied in a sympathetic spirit. A laboratory of that sort was too great a luxury for the individual firm. Possibly an X-ray institute or something of the kind might be set up whose particular province it would be to thresh out these problems.

Mr. **Cuthbert Andrews** said that at present in this country there were a small number of separate firms, some of them very large as businesses went nowadays, each working independently for a comparatively small clientele. Up to now there had been little or no cooperation and therefore no chance of economising or simplifying production so as to enable these firms to compete properly in the world market. How could such methods hope to succeed against the huge concerns of Germany and America with their standardised apparatus, large output, experimental facilities, and world-wide representation? The British conditions were not due wholly to lack of enterprise. The difficulties in the way of reorganisation on the lines of a more efficient system up to now had been very great—some financial, some sentimental, and some dyspeptic—but the war had altered things, and now there was every chance of such an understanding between electro-medical firms as would enable them, not only to give a vastly better service to customers at home, but to conduct a vigorous campaign in the colonial and foreign markets. But to secure this there must be a frank interchange of ideas between the profession and the various houses, an increase of respect and a decrease of suspicion, and a mutual willingness to come into line and pull together for the good of all concerned.

Dr. G. B. **Batten** thought that the commercial distrust of the inventor by the manufacturer had something to do with the condition of affairs. We were generally so frightened of the crank that we rejected the ideas of the inventor without adequate examination.

The discussion was adjourned to the next meeting of the Society.

REVIEWS.

A Manual of Practical X-Ray Work. By D. ARTHUR, M.D., D.P.H., and J. MUIR, B.Sc., M.B., Ch.B., Capt. R.A.M.C. (T). Demy 8vo, 366 pp., 185 illustrations, 12s. 6d. net. Wm. Heinemann (Medical Books) Ltd., London.

This manual was originally published in 1908 for post-graduate workers, especially Army and Navy Surgeons. The stimulus of the war has now resulted in a second edition of some 300 odd pages. It is naturally easy in a practical volume covering so extensive a field to find details for criticism.

In parts the book is well written, while in others it appears cursory. One finds throughout the volume several statements of some practical bearing which need fuller explanation unless likely to lead to some confusion of idea and procedure among new workers. Such as the statement that a "soft tube gives a greater amount of X rays than a hard tube," and that the "chief function of the condenser is to minimise inverse current." One is almost tempted to ask the authors, what occurs inside the working brake? Why the various mechanical rectifiers?

The time seems to have arrived when accumulators should hold little place as a source of energy, at best demanding constant attention and anxiety, both as to their condition and efficiency to say nothing of expense, while generator outfits can now be easily installed within the compass of a motor ambulance, which bear no comparison for efficiency, without the inconveniences and are equally suitable for the sick bay afloat or the field.

The chapters on localisation and therapy are in places descriptive and sketchy for a practical volume. The book contains a mass of information, is well printed and bound. Some of the lithographs might be replaced by practical diagrams to help the text. Many of the reproductions of skiagrams are so poor as to be almost worthless. The volume is fairly up to date, and undoubtedly will fill in part the want for which it is written, in this rapidly changing branch of medicine and surgery.

The Pathology of Tumours. By E. H. KETTLE, M.D., B.S. Lond. Pp. viii. + 224, 126 illustrations, Demy 8vo, price 10s. 6d. net. H. K. Lewis & Co., Ltd., London.

In reviewing this book one must bear in mind the object set out in the preface, "to present as briefly as possible the chief points bearing on the general and special pathology of neoplasms." Hence much of the first natural criticism, that it is impossible adequately to deal with so large a subject as the new growths in a volume of this size, falls to the ground. As might be expected from the author's extensive experience, the faults are more those of omission than of commission, and provided that the reader be desirous of obtaining a sound but yet not an exhaustive knowledge of the subject, Dr. Kettle's book may safely be recommended. Debateable questions, such as those surrounding the endotheliomata and hypernephromata, are not discussed at length, and we are left to infer the author's own view rather than are presented with it. As a result, dogmatic teaching, in the aggressive sense, is conspicuously absent, and though the reviewer, of necessity, would differ from certain of the opinions expressed (especially if he himself should have devoted some years to the study of the new growths), he would be bound to feel that the salient features of a very complex subject have been presented accurately and fairly.

On the other hand, treatment of the new growths—assuming that the author is right in including *treatment* in a work on pathology—surely demands more than four pages. Radiological treatment of malignant neoplasms alone has made sufficient progress during the last few years to merit more remark than 'various caustic substances . . . are now entirely replaced by applications of X rays, radium, or carbon dioxide snow, or ionisation," and "Applications of X rays or radium may be employed to relieve local symptoms" (p. 55). This scanty information is unimportant for readers of The Archives of Radiology and Electrotherapy, but might produce a faulty impression in the minds of medical students and practitioners untrained in radiology.

But few printer's errors have been noted. The illustrations and the indices are good.

W. S. L.-B.

NOTES AND ABSTRACTS.

RADIOTHERAPY.

The use of Filtered X rays for the Relief of Fibrous Bands and Adhesions resulting from Bullet Wounds.—A. W. Williams (*British Medical Journal*, Dec. 2nd, 1916, p. 754).—The author, in the hope of removing new fibrous tissue giving rise to trouble in deep wounds, has used X rays. He uses a ·5 mm. aluminium filter and tubes of a hardness of No. 7 Benoist and Sabouraud doses were administered.

Four cases are quoted as having shown improvement.

R. W. A. S.

The Sensitizing Effect of Cold on Roentgenized Surfaces.—C. A. Simpson (*American Journal of Roentgenology*, October, 1916, p. 485).—The author quotes four cases in which ice had been applied to the neck before X-ray treatment. In all the cases he obtained a severe skin reaction with as little as 3½ units Hampson, filtered through 1 mm. aluminium, the skin being protected from secondary rays by five layers of chamois skin. A case is illustrated where the upper thorax as well as the thyroid region was treated simultaneously, and it was found that the reaction was always confined to the surface which had been in contact with the ice bag.

The ice bag, in the author's experience, has proved such a skin sensitizer that he allows only those patients to use it who have derived the greatest benefit from it in the past, and he makes allowances for the skin reaction by giving always less than three and a half points Hampson.

As to the reactions, they begin from two to five days after the exposure. The redness reaches its most noticeable stages on the fourth or fifth day, persists for a week or ten days, when it begins to fade. He has never seen severe symptoms, such as vesiculation or bulbous formation, but only a dry, red, congested, slightly sensitive area whose borders outline the position of the ice bag. At the end of three weeks, all that remains is a hyper-pigmented area resembling the results following a mild sunburn. On this discoloured surface the uppermost layers of the skin may sometimes peel off in little islands. There are no signs of tenderness, scar, atrophy or telangiectasis to mark the sites of the previous reaction.

R. W. A. S.

RADIO-DIAGNOSIS.

An Appreciation of the Roentgen Ray and a Warning as to its Use in Surgical Diagnosis.—C. H. Mayo (*Amer. Jnl. of Roentgenology*, Oct., 1916, p. 474).—An appreciation coming from so distinguished and experienced a surgeon as Dr. Mayo is naturally of the greatest interest. The author briefly reviews the growth of the use of X rays in medicine and surgery, and utters some warnings which may well be weighed.

The treatment of certain fractures has been almost revolutionized by early X-ray diagnosis and aid in adjustment, and surgeons have become convinced of the necessity of the open method of treatment in cases of failure of adjustment. Radiographs must, however, be properly interpreted. Many operations far too radical, such as amputation of limbs, have been advised in the belief that death from sarcoma would otherwise result, while the disease was but bone cyst or cartilaginous tumour.

Especially important is their aid in the diagnosis of early metastatic carcinoma of the lung and bones. In these cases the Roentgen findings prevent serious primary or secondary operations when the original lesion is in the mammary gland or thyroid. When such malignancy has existed for more than a year there may be 14 per cent. of metastases to lung and bone. The author believes that these structures should not be treated surgically when such metastatic growths are found, and that other forms of treatment have greater influence in prolonging the life and comfort of the sufferers.

In diverticula of the œsophagus, the ray shows when there are large sacs extending into the chest, and indicates when a two-stage operation should be done to prevent danger of infecting the mediastinal space, a complication that is usually fatal.

In diseases of the stomach, the surgeon depends largely on X rays to identify and locate the niche of ulcer, hour-glass stomach, the location and operability of cancer, contractions at the pylorus, and foreign bodies, also to determine whether a palpable epigastric mass is intrinsic or extrinsic. Formerly such conditions were often diagnosed as surgical lesions, and a complete diagnosis revealed only by exploration. Thus, many persons suffering from inoperable carcinoma have been subjected to unnecessary operation, their vitality being thereby impaired without adequate benefit. Probably no organ is more often the seat of common complaint than the stomach, but, as W. J. Mayo says, so frequently are those symptoms reflex that only one person in ten who complain of gastric trouble as the major symptom actually has disease of the stomach. In an extremely high percentage of cases duodenal ulcer is diagnosed by bulbar deformity, obstruction, and hyperperistalsis. Secondary manifestations in the stomach, such as pyloric spasm, hyperperistalsis, etc., often indicate infection of the gall bladder, with or without adhesions. The complaint referred to this region is probably more exaggerated than that referred to any other region of the body, unless it is the female pelvis, and it has often an hypnotic influence. However, it is the examiner who receives the suggestion and is led to exaggerate the findings. The unfortunate surgeon, failing to find the supposed lesion, pleases neither the patient nor the diagnostician. It is to be deplored, says Dr. Mayo, that so many suggestions coming from the profession are of disease rather than health.

The stomach and colon being easily located readily show changes of position which are often supposed to be abnormal, and have led to much inadvisable surgery. Those engaged in specialities occasionally fail to comprehend the association of general diseases, the habitus, the muscle tonus, the height, breadth, weight, and the influence of environment, and the narrowness of the view point of the specialist often accounts for the unwarranted operation recommended. The surgeon is frequently confronted by patients who have been hypnotized by the suggestion of physicians into believing they have disease. These patients appear with a box of plates showing their stomachs are low. Their physicians have recommended gastro-enterostomics or colectomics, although there is but slight, if any, delay in the emptying time. Such persons are usually women, though sometimes they are men, still worse subjects. They have weak muscles, are usually tall, narrow of girth, and long of loin, and therefore it would be surprising to find that the longitudinal muscles of their colon were in proper tone. With but a few inches of lateral width in which to attach 24 inches of transverse colon, the latter naturally hangs lower. If stasis is present, these patients have been told that all their ills, mental and physical, will be relieved by elevating or shortening the colon, and the surgeon who refuses to operate is looked upon as an obstructionist.

In genito-urinary work, a knowledge of the presence of multiple stones is of the greatest importance, as it is generally believed that recurrence of stone in the kidney occurs in 50 per cent. of the cases. In a series, in the Mayo clinic, of 450 cases of stone in the kidney, operated on more than a year ago, the actual percentage of recurrence was 9·9, but the number of multiple stones diagnosed and removed was high. Deformities of the pelvis of the kidney are outlined by the pyelogram, thus making possible early diagnosis and operation on hypernephroma.

Diseases of the gall bladder are the result of infections, specific types of streptococci having been brought to the base of the mucosa by the vascular stream. Gall stones do not develop without previous inflammation of the gall bladder. Undoubtedly, a great deal of effort has been wasted by the radiologist in endeavouring to diagnose gall stones. It can be done in a certain percentage of cases, but if even done correctly in 100 per cent.—it is correct in scarcely half that number—the method avails nothing in the group of patients suffering from cholecystitis without stones, strawberry gall bladder, papillary gall bladder, and even early carcinoma patients, who make up more than one-third of the total number of those with gall bladder disease.

Very frequently foci of disease are carried by those suffering from chronic relapsing rheumatism, neuritis, myositis, etc. One of the most common sources of such infection are painless apical abscesses in the jaw, which empty into the circulation from time to time through the venous channels in the bone, each delivery constituting a new attack, or so-called relapse. In the search for such foci of infection the Roentgen ray quite naturally supersedes all other means of examination.

The author, in conclusion, urges that the radiologist should be specific in his conclusions, avoiding lengthy descriptions of his findings, and when unable to make a diagnosis, frankly reporting the case as "indeterminate." Radiologists, Dr. Mayo thinks, seldom have the opportunity of following their patients to the operating table and visualizing the abdominal contents directly. Nor do they have the opportunity to correlate their findings with those of equally good men who are quite as anxious to show the importance of laboratory and clinical tests and well-taken histories. Only by such correlation can a normal, wholesome restraint be established and the greatest proficiency in clinical diagnosis be attained. R. W. A. S.

Some Aspects of Special Interest Bearing on the Roentgenological Diagnosis of Tuberculosis of the Lungs.—H. Hulst (*American Journal of Roentgenology*, Oct., 1916, p. 465). —The author reviews at length the characteristic appearances said to be present in this disease by various radiologists, tries to correlate them, and hopes that some constantly present pathological basis will be found to explain them. Practically, he says, we shall seldom go wrong if, instead of relying exclusively on one so-called characteristic sign, we look with a more open mind for all the characteristic signs known or possible. Whether we believe the bronchi, the lymphatics, or blood vessels to be chiefly or primarily involved, we satisfy all if we approach the study of the radiograph by way of the hilus ramifications in all cases not clearly miliary. Radiologists have learned to look upon the region of the hilus and hilus ramifications following the upper vertebral branch of the upper lobe bronchus as the one to be first suspected in early cases. With short exposure technique, changes were detected along this ramification higher up as well, often of a more delicate nature, until now the distal endings reveal even more characteristic changes than does the hilus. At the periphery, the bacilli are first halted, and the earliest signs in adults are to be expected there.

Nikol finds that the most typical of all lung lesions, the acinous nodular focus, depends for its location and macroscopic and microscopic appearances upon the anatomy of the structural unit of all lung tissues, the lobulus. This lobule is made up of an intralobular bronchus giving off two or three collaterals and two terminal bronchi with their dichotomous bronchioli, each again giving off smaller branches. The terminal structure is the acinus bronchiolus. This corresponds to the bronchiolus respiratorius in Quain's "Anatomy." Here the alveoli begin and ciliated epithelium leaves off. Each bronchiolus gives off three or four alveolar passages. An acinus, therefore, is the domain of a bronchiolus respiratorius with the alveolar passages appertaining to it. Acini are more uniform in size than lobuli. A lobule contains from fifty to one hundred acini. Lobules do not anastomose but interdigitate with each other, as do also their accompanying lymphatics and blood vessels.

The bronchiolus respiratorius is first involved in acinous tuberculosis as well as in non-tuberculous broncho-pneumonia. The acinous foci conglomerate into small and larger sized nodules. To the naked eye the acinous nodular focus appears as a conglomerate of small, greyish-blue bodies, which look like miliary tubercles. Acinous foci occur in groups at the end of the bronchi and form clover leaf and rosette-like bodies, while miliary tubercles are more evenly distributed over the whole lung, diminishing in size from apex to base.

These rosettes of millet-seed-sized nodules may stand for the islets of mottling so much insisted upon by many as an early and characteristic sign.

The leaves (mottling) which hide the branches in spring and summer, after falling leave the bare branches standing out boldly as against a clear sky, when healing has taken place. Viewed thus, the acinous nodular focus is the prototype not only of one form of chronic and subacute phthisis but of caseous broncho-pneumonia and tuberculous bronchitis as well, and becomes the key to the interpretation of the radiograph.

R. W. A. S.

The Roentgen Examination as an Aid in the Differential Diagnosis between Pneumonia and Empyema, especially in Children.—W. H. Stewart (*American Journal of Roentgenology*, Dec., 1916, p. 559).—The author discusses the clinical difficulties of diagnosis in lung conditions, and brings to notice new theories of the apparent discrepancies at times found in the physical signs.

In the diagnosis between pneumonia and pleural effusions he states that the radiologist can, in the majority of doubtful cases, clear up the diagnosis long before positive physical signs appear. He finds the character of the shadows cast by fluid in the pleural cavity depends entirely on the quantity and the presence or absence of adhesions. The most common finding in a simple pleural effusion of moderate amount is a dense shadow extending upward from the diaphragmatic line, with a cup-shaped irregular upper surface. In children, even without adhesions, there may be a clear area of lung structure between the fluid and the root down to the diaphragm. This is especially so in beginning effusions, where the shadow of the fluid seems to extend upward on the parietal pleura before overshadowing the lung markings at the base. As the pleural cavity fills—and it usually does so rapidly in children—the entire side becomes occupied by a dense cloud, which completely overshadows the lung structure. This is usually associated with some displacement of the mediastinal contents to the opposite side, although this occurs much more frequently in adults than in children.

If adhesions are present, the effusion may become encapsulated, in which case the shadow of the fluid usually appears as a globular mass encroaching upon the lung structure from the cortex toward the root, the base of this shadow conforming to the shape of the chest. This sacculation may occur high up, or at the base; or it may be anterior or posterior.

It is pointed out by the author that a former pleural effusion may leave a thickened pleura sufficient to cast a shadow similar to that of a pleural cavity filled with fluid.

The shadows cast by a pneumonic process usually commence at the cortex of the lung; in the early stage, being limited to one lobe, the most common is the middle right. The consolidation is generally wedge-shaped in appearance, with the base at the pleural surface and the apex toward the root; it spreads laterally and inward toward the root until the entire lobe is involved. There may be an extension into other portions of the lung, but even this extension usually spreads in the same manner. The peculiar, wedge-shaped shadow found in pneumonia is quite characteristic and differentiates this lesion from an encapsulated pleuritic effusion. The latter has a sharp edge, circular in form, which extends inward from the cortex, and the sacculation does not limit itself to one lobe.

Root pneumonia assumes a somewhat different course. The consolidation appears as a dense, fan-shaped shadow spreading toward the periphery, the outer edge being very irregular. It extends from the hilus outward, involving more than one lobe; many cases do not reach the cortex.

Pneumonia is frequently complicated by an empyema, and then, the author states, the radiographic findings as to the presence or absence of fluid are most important, especially in a draining, suppurating pleurisy where there is a sudden rise in temperature which cannot be explained. In such cases X rays will usually reveal a consolidation above the drained area.

The paper is illustrated by very many radiographs, with full clinical notes and comments.

R. W. A. S.

ELECTRO-DIAGNOSIS.

The Electrical Reactions of the Injured Nerve.—R. Desplats (*Journal de Radiologie et d'Electrologie*, II., 4, July-August, 1916).—Electrodiagnosis is often called upon to give the prognosis of a case of nerve injury, and to say what degree of damage has been sustained. The former can only be done after several examinations, the first supplying a starting point for comparison. For the latter, it is not possible to distinguish between severe contusion and complete division.

Efforts at further elucidation of the matter have followed the line of testing the nerve trunk. Léri and others, by observations on the exposed nerve at operation, have shown: (1) That in every nerve trunk the distribution of fibres representing individual muscles follows a definite topographical plan. (2) No matter how dense or how old the surrounding scar tissue no nerve loses its conducting power unless it has been divided or crushed.

During the same time (1915), the author has collaborated with Battez in making observations on nerve trunks through the intermediary of the skin. The first question to be decided was whether a nerve which is inexcitable below the lesion is necessarily inexcitable above as well. They soon found that 80 per cent. of their cases showed some degree of response to faradic stimulation above the lesion, in other words, conductivity remained though there was loss of excitability below. Cases could be classified according to three or four distinct types, and those which were further examined by operation showed that for similar groups of cases there was a complete parallel between the author's percutaneous "reactions of conductivity" and the behaviour of the exposed nerve as described by Léri.

A further point is, that after the operation for freeing the nerve from adherent scar tissue, examination a month later showed no change in the reactions; some nerves did not begin to recover excitability below the lesion until five or six months after operation.

The author's main conclusion is that presence of the "reaction of conductivity" implies continuity of fibres in the nerve trunk, but absence of the reaction does not prove that there is complete division.

N. B.

CORRESPONDENCE.

To the Editors of Archives of Radiology and Electrotherapy.

Sirs,

Many electrotherapists must have read with some surprise the following passage in the extremely interesting and valuable paper which Captain Adrian contributed to the May number of your journal.

"For example, it is generally held that daily treatment with the galvanic current, or some other form of electricity, is essential to the well-being of the paralysed muscle; and yet the most recent and the most accurately controlled observations suggest that such treatment has little or no effect at all." In support of this contention two references are given: Lovett, "The Treatment of Infantile Paralysis," p. 70, 1916; Langley and Kato, *Journal of Physiology*, XLIX, p. 432, 1915.

This statement is in such direct contradiction of the well established views held by electrotherapists, both in this country and in France, since the days of Duchenne of Boulogne, and so opposed to the experience gained in the treatment of peripheral nerve injuries during this war, that I referred with great interest to the two articles upon which Captain Adrian bases his opinion.

In these references I must confess that I found nothing to justify Captain Adrian's conclusions.

Let us deal first with "The Treatment of Infantile Paralysis," by Lovett. On reading the few pages devoted to electrical treatment in this book, it soon becomes clear that the author has neither knowledge nor experience of modern electrotherapeutic methods, and one looks in vain in this work for any "accurately controlled observations."

"The faradic current," Lovett writes, "acts directly on the muscle." This is hardly in accordance with the teaching of Captain Adrian that faradism acts directly on the nerve, and only indirectly on the muscle. Lovett considers that faradism is "theoretically of benefit when contraction of a muscle cannot be produced voluntarily. But it is evident that it is not a very powerful means of exercise, and practically it is disagreeable to the patient, and to young children a source of terror." It is evident that the writer has not sat in a Bergonie chair, or he would hold different views regarding the degree of exercise which can be excited by the faradic current. The bugbear of the disagreeable and fear-inspiring character of the rhythmically interrupted and reversed faradic and galvanic currents is only put forward by those who are unacquainted with the proper mode of their administration. In a well conducted electrical department the most nervous children, after the first few treatments, play with their picture books, and often fall asleep, while their paralysed muscles are rhythmically contracting under the influence of the galvanic or faradic current.

"The galvanic current, on the other hand," according to Lovett, "is used to promote the conduction of nerve impulses, and for an indefinite general effect on the nervous system, which its advocates believe it to have." It does not appear to have occurred to Lovett, or at any rate he makes no mention of the fact, that interrupted galvanism may be utilised to excite contraction in those muscles which fail to react to faradism.

Treatments by condensers, sinusoidal currents, the Morton wave current, etc., are grouped together, and are summarily put aside as being more obscure in their mode of action than even the galvanic current.

Of high frequency currents he writes at rather greater length, and quotes, and rightly condemns, some antiquated notions of their mode of action, such notions as certainly would not be put forward by any modern electrotherapist.

Of the thermal action of these currents, and of diathermy he does not seem to have heard.

This summary of the electrical contents of "The Treatment of Infantile Paralysis" is sufficient to show the value of the information relating to electrotherapeutics which is to be obtained from this book.

The paper, "The rate of loss of weight in skeletal muscles after nerve section, with some observations on the effect of stimulation and other treatment," by the distinguished physiologists, J. N. Langley and Togojiro Kato, certainly calls for more serious consideration. I think, however, that the authors would be the last to claim that their paper showed the inefficiency of electrical treatment in peripheral nerve lesions; on the contrary, so far as the experiments went, though it must be confessed they went a very short way, they tended to prove the value of condenser stimuli in delaying the atrophy consequent on nerve section, for in their summary at the end of the paper the authors state:—"The experiments were not numerous enough to give decisive results, but they tended to show that electrical stimulation with condenser shocks delays the atrophy, that rhythmical extension of the muscle has a similar but less effect." All electrotherapists will most heartily welcome the further statement of these writers:—"It is of considerable practical importance to determine the best means of delaying muscle atrophy, since the better the condition of the muscle the quicker will be complete restoration of voluntary control after motor nerves have been severed."

The experiments were performed on rabbits. "In all cases but one the internal popliteal nerve was cut, and the gastrocnemius, soleus, and plantaris muscles, with their tendons up to the level of the insertion of the tendo Achillis were weighed after death." The stimulation was by condenser shocks ·016 to ·025 M.F. from the Lewis Jones apparatus.

Experiment 1.—Tibial nerve cut on one side. Massage for five minutes till the tenth day. Condenser shocks for four minutes, with subsequent massage for three minutes on the following fourteen days. The large positive pole, 3 by 2 inches, was placed on the thigh, the small negative pole, ·5 cm., was placed on different parts of the calf of the leg. The stimulation caused contraction of the thigh muscles, contraction of the gastrocnemius was only obtained with a minority of the stimuli.

Experiment 2.—On nine days condenser shocks thirty-six times a minute for eight minutes. Two small electrodes were used and both placed on the lower part of the calf of the leg. Contraction of gastrocnemius was obtained with nearly all the stimuli.

Experiment 3.—Massage, but no electrical treatment.

Experiment 4.—Tibial nerve cut on both sides. Massage for five minutes till the tenth day, condenser shocks as in Experiment 1, with subsequent massage for three minutes on the following seven days.

Experiment 5.—Condenser shocks as in Experiment 1.

Experiment 6.—A short steel plug was passed through the gastrocnemius with the plantaris; at death the plug was slightly corroded, but had caused no inflammation. About 200 condenser shocks as in Experiment 2.

Experiment 7.—Peroneal nerve cut on both sides. Treatment as in Experiment 6, but no peg inserted in muscles.

An electrotherapist certainly would not expect any appreciable benefit from treatments of such short duration, or from such a short series of treatments, as were made in these experiments. It is, therefore, surprising that the slightest delay of atrophy was found to result from these experiments.

Again, the electrotherapist would expect the chronaxie of a muscle, deprived of its nerve, to be far longer than 1-1600 second, the time duration of discharge of the strongest condenser used in these experiments. Perhaps, however, and this probably was the case, sufficient time had not elapsed for the nerve and muscle to fully degenerate. In that case, the experiments would not hold good in regard to muscles which had reached a more advanced degree of degeneration.

On the whole then, one is forced to conclude that these carefully controlled experiments have little or no practical value in solving the problems of the electrical treatment, either of infantile paralysis or of peripheral nerve lesions. Personally, I do not think that, with the deplorable wealth of human material at present available for these investigations, much is to be gained from experiments on animals. Captain Adrian indicates the better line of research when he advocates the demonstration of therapeutic benefits, or the reverse, by means of the progressive shortening or lengthening of the chronaxie of the degenerated muscle. Unfortunately, those who have the greatest experience in the treatment of these cases have the least time to devote to such investigations.

Yours sincerely,
W. J. Turrell.

Oxford, August 9th, 1917.

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Policlinico, Il., July 15th, August 1st, 1917.

Quarterly Journal of Medicine, July, 1917.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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ELECTROTHERAPY IN MILITARY HOSPITALS.

During the present war more electrical treatment has been administered than at any previous time. Electrical departments have arisen in the various military hospitals throughout the country. Not only in these, but also in the civilian hospitals in which wounded soldiers are received, numerous patients are being treated by electrical methods. Cases that are seldom or never seen in times of peace, such as shell-shock and trench-foot, are receiving their trial of electric treatment, while others which do not form a large part of the practice of electrical departments, such as neurasthenia and the various neuroses, are being treated in large numbers, so that a more accurate estimate of the value of electrical treatment of such cases can be obtained. Cases of nerve injury are now seen in larger numbers than ever before, and much experience is being obtained of the uses of electricity in their diagnosis and treatment.

Little has been published in the medical journals on the Electrical Departments of military hospitals. In the present number of the ARCHIVES is an account of the Electrical Department of the Horton War Hospital, Epsom, by Lieut. N. M. H. Burke, R.A.M.C. (T.), in which he describes the types of cases that have been treated there, and the methods which he has found to be most suitable, and the results obtained. We feel sure that accounts of the work in the Electrical Departments of other hospitals will be of interest to those who are engaged in such work. There is but little time or opportunity for those engaged in military medical work to visit other hospitals in other parts of the country so that the methods of treatment, which one worker may have found to be eminently suitable for different cases, are not readily communicable to others.

We shall be glad to receive for publication accounts of the work of Electrical Departments in other hospitals.

ELECTROTHERAPY IN MILITARY HOSPITALS.

I. HORTON (COUNTY OF LONDON) WAR HOSPITAL, EPSOM.

By **NOEL H. M. BURKE**, M.R.C.S., L.R.C.P.,

Temp. Lieut. R.A.M.C. ; Medical Officer in Charge of Electrical Department, Horton (County of London) War Hospital, Epsom.

DURING recent months the various medical journals have published descriptions of the electrical work of command depôts, convalescent camps, and special orthopædic hospitals ; no account has as yet appeared of electrotherapy as practised in the large central military hospital, where the work is different from that of any of the other resting places in the path of the wounded soldier.

Before discussing the electrical department of any hospital, it is necessary to attempt to review the position and function of the hospital at varying stages in the course of the War.

General Considerations.—At first it was possible, and, indeed, necessary, to keep in hospitals, and for a long time, many of the cases needing electrical treatment. It was then possible to watch progress and see definite results in quite chronic cases such as sutured peripheral nerves.

Later on the convalescent camp was established to deal with men who were likely to be fit for service in six weeks. This removed a number of patients who were causing congestion in the acute hospitals. It also led to a new and somewhat special class of case ; for men suffering from nerve injuries, stiff joints, etc., in a late and chronic stage, were constantly sent to convalescent camps when not in the least likely to be fit for duty in the stipulated time. Such cases were immediately passed on to the nearest central hospital, and so the cast-offs from other places were admitted and found to form a distinct class of their own.

Later again command depôts were established for men who, while well enough to stand life in a hutted camp, were in need of active physiotherapy and likely to be fit for some fairly good category of service at the end of six months treatment. This was a great blow to the electrical departments of the hospitals, as it was their cases especially who had to go to command depôts. The result was that cases were seen in the former for a shorter time, and few could be followed up to the same stage of cure. From the point of view of records this is, of course, the defect of military medical work throughout. Each patient has of necessity to go through many stages, each under a different doctor, and continuity of treatment and the making of an accurate and complete history of the course of events and the results obtained is difficult to achieve. The effect of this must be borne in mind when considering figures showing the results of the work of any department in any military hospital, and will be exemplified below. The last phase of the history of medical organisation that affects electrotherapy in central hospitals is the new speeding up, whereby cases come rather earlier from France and go on earlier to other places. They are, therefore, less soon ready to be sent to the electrical department after arrival and are only able to be kept for a shorter time before they are due to go on. The average stay in the care of the electrical department is reduced and the achieving and noting of definite results is by so much lessened. There is also the often unnecessary result that medical officers in charge of wards may think it not worth while to start electrical treatment because a man is likely to go out in a week or two to complete his recovery elsewhere. This leads to fewer cases being sent down and consequent loss of time in getting men fit for duty.

Local Considerations.—The Horton Asylum, at Epsom, was converted into the Horton (County of London) War Hospital, and opened for reception of soldiers in May, 1915. The first convoy arrived direct from France on June 16th, 1915. There are 2,532 beds, of which half were filled by August, 1915, and most by September, 1915. During the first half of 1916 the hospital was only moderately full ; since then it has been constantly above the 2,000 level.

Besides general and mostly acute cases from the various fronts, the hospital is a centre for eye work and for ear, nose and throat patients, and deals with the sick from the Eastern Command.

The cases from Woodcote Park Convalescent Camp are sent to it for hospital treatment, and mostly reach the electrical department ; latterly the neighbouring Manor War Hospital has sent over its electrical cases to Horton for examination and treatment. It will be seen, therefore, that there has been a large, and until this spring a fairly growing population from which the electrical department has drawn its material.

The First Electrical Department of Horton War Hospital.—Quarters were found in a small room, with water supply from a lavatory basin in a little anteroom. Four wall sockets and the lamp socket were made available so that five instruments could be kept running off the 200 volts d. c. supply. At first the apparatus consisted of two combined switchboards, a galvanic switchboard and Lewis Jones condenser apparatus. In another room were one set of Schnee baths with a polystat and Lewis Jones rhythmic interrupter. A small radiant heat apparatus was also used occasionally.

Owing to preliminary trouble with the polystat a small motor was obtained, and another rhythmic interrupter to work the baths in connection with one of the combined switchboards.

In this small space and with this small apparatus a great deal of work was done, until in May, 1916, it was found absolutely necessary to move into more adequate quarters, which were found in a central part of the main building.

Second Electrical Department and Equipment.—This consists of two large rooms, which were formerly the bathing and dressing-rooms for the male patients of the asylum. There is consequently ample floor space, and an ample water supply, and work is thereby rendered easy.

Special wiring was put in, independent of the existing lighting installation, and as simple a plan as possible was followed. The probable load was divided up between two 3/20 circuits, which supplied three boards fitted with ordinary lamp sockets, from which connection could be made. Either circuit can take 3 amperes, and the whole set of instruments together only uses 3½ amperes, so that there is an ample margin.

Since moving into the new rooms additional apparatus has been obtained as follows :—

Three Water-resistance Machines after the suggestion of Leduc.—These were made by our own skilful electrician at a cost of between 12s. and 15s. each, and are excellent instruments for use in any employment of the direct current.

One High Frequency Generator, made by the Sterling Corporation, which though a small and inexpensive apparatus, is yet quite useful in many cases.

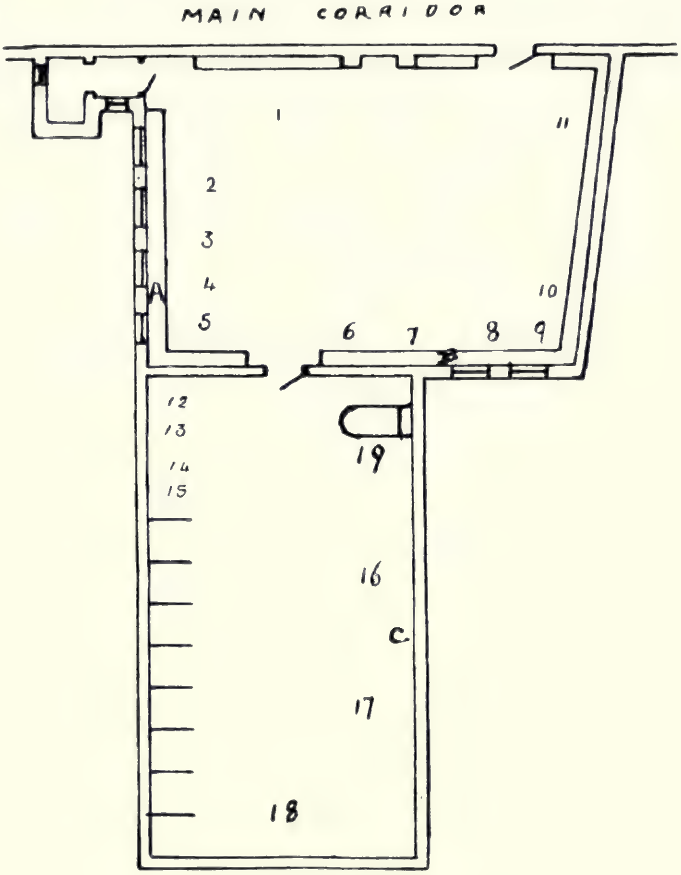
An *Installation of Eau Courante* or whirlpool baths—two for arms and two for legs—made by our own tinsmith and fitted up according to our own modification of the original French pattern. This is, of course, not electrical, but the department undertook the extra work as it had the necessary water supply, and it already dealt with most of the cases which were likely to benefit by whirlpool baths.

The accompanying plan of the rooms will most readily describe the general arrangement.

PLAN OF ELECTRICAL DEPARTMENT AT HORTON WAR HOSPITAL.

Description.—1. Medical Officer's table, where cases are examined, and whence supervision can be maintained over both rooms.

2. High frequency apparatus.
3. Condenser apparatus, used for treatment as well as for muscle-testing.
4. Combined switchboard for treatment and testing.



SCALE 16 FEET TO ONE INCH

5, 9. Radiant heat.
6, 7, 10. Water resistance galvanic machines.
8. Galvanic switchboard.
11. Benches where patients wait their turn.
12, 15. Whirlpool baths.
16. Schnee baths—Polystat and Lewis Jones interrupter.
17. Baths—combined switchboard, and motor operating Lewis Jones interrupter.
18. Store cupboards, etc.
19. Full length bath for water supply.
A. B. C.—Boards holding connection sockets.

Personnel.—The work is done entirely by time table and appointment, so that confusion is avoided, patients are seldom kept waiting, and there are no periods of intense rush alternately with times of idleness. Special treatments, such as sinuses and open wounds, are carried out by the medical officer in charge; otherwise his time is fully occupied in seeing cases—new and old—keeping the notes and records in order, and controlling the work generally. All ordinary treatments are given by two male orderlies specially trained and under constant supervision. Patients begin to attend at 8 a.m. and are all dealt with by 5 p.m. The rest of the orderlies' time is required for cleaning the instruments, delivering notes and reports, winding bandages, and so on. A third orderly keeps the rooms and fittings clean and does the dirty work generally.

Types of Cases Seen, Methods, and Results.

1. *Peripheral Nerve Injuries.*—These constitute about a half of the cases dealt with.

A. Testing is done by the old-fashioned faradic and galvanic method; the condenser responses are noted as well in nearly all cases. Less reliance is placed on the latter than was the case a year or so ago. No diagnosis is attempted without a second thorough examination after an interval of three or four weeks of treatment; much importance is attached to the result of stimulating the nerve trunks above and below the lesion. Some 85 cases have come to the operating theatre, and in most of these the exposed nerve trunks have been electrically tested by a sterilizable electrode.

B. Treatment follows no hard and fast line, but is prescribed according to the special requirements of each case. For instance, in a case of nerve concussion, compression by scar, or after operation, a galvanic current is passed through the seat of trouble to improve the local nutrition and help absorption of inflammatory products.

For maintaining muscular tone and the general nutrition of the limb, some form of rhythmically varying current is used—sinusoidal, faradic, or condenser discharges.

The old and somewhat unproven theory that muscular contraction must of necessity be produced is not followed at this hospital. The use of the sinusoidal baths instituted by Lewis Jones, at St. Bartholomew's Hospital, has shown conclusively that excellent results follow treatment whereby no visible contraction is produced, and similar methods are employed at Horton with equally good results. For circulatory disturbances, especially in cases complicated by ligature of vessels and for neuritic pain, the "Eau Courante" has proved its value many times. These methods are used in conjunction, of course, with the necessary mechanical support to weak muscles, and in most cases massage is also employed.

The results are very satisfactory; trophic ulcers are very rare, pain is greatly relieved in nearly all cases, and return of function occurs in all cases that can be followed for a reasonable length of time.

2. *Scars*, causing limitation of movements, have been treated with chlorine ions, high frequency, or whirlpool baths, immediately followed by massage, and good results recorded.

3. *Stiff joints* have yielded well to galvanic currents, and to whirlpool baths.

4. *Pain (a). Neuritic.*—There have been excellent results of eau courante treatment in acute traumatic neuritis; other cases have responded better to salicyl ions.

(*b*) Crushed backs after burial have received most benefit from salicyl ions.

(*c*) The painful shins of trench fever have done very well with rhythmic sinusoidal baths.

(*d*) Chronic sciatica, lumbago, and other vague and probably rheumatic conditions, have shown somewhat disappointing results, largely in proportion to the previous duration of the ailment.

5. *Trench Feet.*—In 1915-16 these were unsatisfactory, as there was then no sinusoidal, high frequency, or eau courante treatment available; in the winter of 1916-17 they did well, with the greater choice of method at the disposal of the department. The painful type did best in baths giving ionisation with sodium salicylate, for the circulatory type rhythmic sinusoidal and whirlpool baths were about equally useful; while in a few cases, where the

presence of gangrenous patches contraindicated a wet method, encouraging results followed exposure to the effleuve of the high frequency vacuum electrode. Altogether two-thirds of the cases treated in the recent season were benefited, one-third were not classified, and none were definite failures.

6. *Chronic wounds and sinuses* have been readily healed by ionic, or by Russ' methods, and occasionally by high frequency. When bone has been involved no definite improvement has been obtained by any electrical method.

So far as statistics are of any value, the following figures will give an idea of the amount and result of electrotherapeutic work in this hospital. The influence of the considerations outlined at the beginning of this paper will explain the decrease of work in the recent months ; it should be noted further that many patients are transferred elsewhere after too short a time for results of treatment to become apparent, others go suddenly and no final note can be made on their condition ; lastly, the transfer of men to other institutions only allows time for a stage in the treatment to be reached in the first hospital, and a man who can be described as "improved" here may get better at another hospital, and be finally "cured" at a command depôt. Few cases can be kept till absolutely cured of all sign of their injury or disease.

In the following classification every effort has been made to avoid overstatement, and to make no undue claims to success :—

REPORT OF WORK OF ELECTRICAL DEPARTMENT, HORTON WAR HOSPITAL, 23rd June, 1915, to 30th June, 1917.

Patients seen and discharged (*a*) in first 11 months, 270, who had had 3,473 treatments.
(*b*) Patients seen following 7 months, 277, who had had 11,339 treatments.
(*c*) Patients seen following 6 months, 328, who had had 6,736 treatments.
Average weekly number of treatments in above periods (*a*) 72 ; (*b*) 377 ; (*c*) 250.

Treatments given	22,548
Patients seen	958
Patients still under treatment	83
Patients discharged	875
Patients not capable of classification when discharged	419

Patients cured	59	= 12·9 per cent.
Patients much improved	106	= 23·3 ,,
Patients improved	268	= 58·7 ,,
Patients not improved	23	= 5·0 ,,

Patients classified when discharged = 456

I am indebted to Lieut.-Colonel J. R. Lord, R.A.M.C., Officer Commanding, for kind permission to publish this article.

TREATMENT OF THE WOUNDED BY MEANS OF ELECTRICITY.

By H. J. Seeuwen, M.D.

Membre fondateur de la Société Belge de Radiologie et d'Electricité Médicale et de la Société Belge de Physiothérapie; in charge of the Electrical, Massage, and Mechanotherapeutic Departments, Heaton Park, Manchester.

I. Scars.

The treatment of scars by electricity has been greatly extended in these last two years. Many articles have been written on this subject, and specialists in different branches of the medical profession claim successes in their treatment of scars on their own particular lines. There is no doubt that this is true.

Ionisation, X rays, ultra violet rays, hot air, radiant heat with white or blue lamps, diathermy, injections of fibrolysin, etc., are very useful in the treatment of painful, adherent, cheloidic, or fibrous scars. Hydrotherapy is another excellent form of treatment.

We are very well satisfied with chlorine and iodine ionisation, but we never use ionisation without some other combined treatment. Massage, for instance, is nearly always used, and I think that massage is often indispensable. For four or five months in the beginning of 1916 we had no galvanic current at our disposal. We treated the scars with massage and remedial exercises only. The results, in a great number of cases, were most encouraging, and sometimes quite good.

With scars you find often some atrophied or contracted muscles, or both. In the majority of cases muscular contraction is a result of the atrophy of the antagonistic muscles.

You find also often neuralgic pains, due to injury or compression of a nerve, or pain, mostly at night, due to circulatory disturbances in the scar tissue. In these cases massage, methodically applied, will be of the greatest value.

For nearly sixteen months, with our present appliances, our usual procedure has been as follows:—Supple and not too tender scars are treated with massage, passive movements, and, as soon as possible, remedial exercises.

Massage, of course, is not only applied to the scar itself, but also to the adjoining region or the whole limb, according to the accompanying lesions or deformities.

When a scar is painful, or adherent, or both, we still give massage three times a week, but each treatment is preceded by an application of hot air or radiant heat.

The duration of hot air or radiant heat treatment depends on the sensibility of the scar, or of the patient. If after three to four minutes hot air application the skin round the scar gets pink it is sufficient, if not the application may go on for five to six minutes if the patient can stand it.

Radiant heat is a somewhat slower proceeding, and may go on for ten to twenty minutes. The massage is proportioned according to the sensibility of the scar and the patient. The three other days of the week, alternating with the massage, we give an ionisation with a two per cent. solution of sodium chloride or potassium iodide.

The active electrode is made with at least twelve layers of gauze, *slightly exceeding* the size of the scar, well soaked in the hot solution. The indifferent electrode, as large as possible, is soaked with hot plain water and is placed on the back or chest.

Instead of an indifferent pad electrode we use, in some cases, a bath for the arm or the leg, especially when the patient is complaining of pain in his limb.

For instance, suppose a man has a scar on his shoulder, or on his upper arm, and complains of pain in his forearm or hand, in this case the scar is treated with a pad over the scar, but the forearm and hand are immersed in a positive plain water bath.

The intensity of the current varies from a half to one milliampere for each square centimetre of the active electrode, or nearly three to six milliamperes to the square inch. The duration of the application is about fifteen to twenty minutes, and sometimes longer.

The patients generally stand these doses very well, the scars are not very tender to the galvanic current, and very often the patient complains of more pain under the indifferent electrode, with a healthy skin, than on the scar.

The scar itself is very seldom irritated by the current, and in few cases have we had to discontinue the treatment for this reason, except with the iodine solution, when the applications went on for over three or four weeks.

Iodine has been sometimes recommended in preference to chlorine. We have tried both comparatively in a great number of cases (about fifty cases of each), and we have not seen any advantage for the iodine. In some unyielding cases we have combined the electrical treatment with massage, and *eau courante* (whirlpool) baths every other day.

We think that this combination of treatment may be frequently employed with benefit where the necessary facilities permit. The results of this combined treatment have been very satisfactory.

The first sign of improvement is generally a diminution of the pain. Sometimes at first the slightest contact is painful, and effleurage only is possible, but gradually massage can be applied deeper and deeper.

With some scars the ionisation at first may also be painful, even with one or two milliamperes to the square inch, but with some care the full dose is possible after two or three treatments. The fibrous and adherent tissues are a somewhat slower proceeding, but gradually they become more and more supple.

What part in the healing of the scar is due to hot air, radiant heat, massage, water, or ionisation?

We think that *all* may contribute to the success. In this treatment one ought not to be exclusive. There are no fixed or uniform proceedings, and it is precisely there that the skill of the operator contributes to the good result.

In the many hundreds of cases that we have treated the duration of the treatment for a simple uncomplicated scar has been on an average from six weeks to two months. If, however, some complications, such as paralysis, neuralgia, contractions, or foreign bodies exist, the duration of treatment is necessarily longer. The X-ray plate can only detect foreign bodies of high density, but there are many other foreign bodies, such as small quantities of dust, or very tiny bits of clothing, embedded in the tissues, which may impede a good cicatrisation.

These fragments, or particles, are often exceedingly minute, and in many cases can only be detected by the microscope. I think this is the reason why many scars remain painful and unhealthy, and, in many instances, the breaking down of a scar after being apparently firmly healed is due to this cause.

If some five or six weeks treatment does not produce a marked improvement in an apparently uncomplicated case the best course is to refer the patient back to the surgeon for further treatment.

SHRAPNEL BALLS—THEIR X-RAY CHARACTERISTICS, COMPARED WITH BULLETS AND OTHER FOREIGN BODIES.

By Captain A. Howard Pirie, C.A.M.C., France.

The following notes are based on the findings from 10,000 X-ray plates, made in about a year, at a Hospital in France, where the writer was in charge of the X-ray Department. During that time we made 241 plates of shrapnel balls and 242 plates of bullets. Much more frequently we found pieces of casing of shells, bombs, grenades, etc., and these were shown on 3,846 plates.

The complete analysis of these 10,000 plates is as follows:—

Fractures, with foreign bodies present	4·25	per cent.
Fractures, without foreign bodies present	11·77	,,
Bullets	2·42	,,
Shrapnel balls	2·41	,,
Other foreign bodies	38·46	,,
Lesions of the chest	1·87	,,
Negative findings	29·93	,,
Unclassified in the above	8·89	,,
Total	100·00	

The "unclassified 8·89 per cent." is made up from such things as exostosis, stone in kidney, stomach plates, etc.

Shrapnel balls may be found entire without any deformity (Fig. 1), and every stage of deformity may be met with till an appearance is obtained as if the ball had exploded into small particles (Figs. 2, 3, and 4). There is

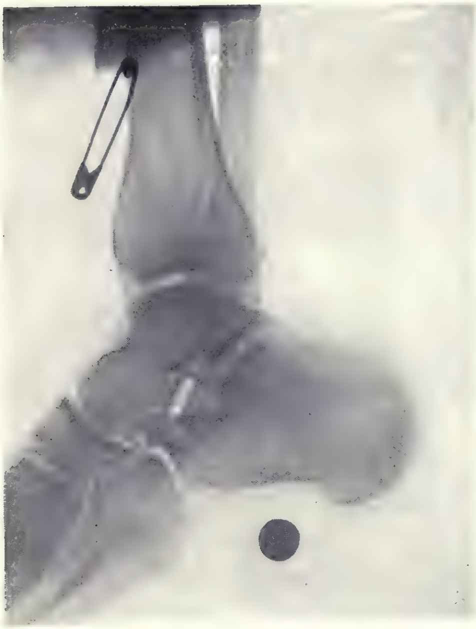


Fig. 1.—An Undeformed Shrapnel Ball in the Foot.

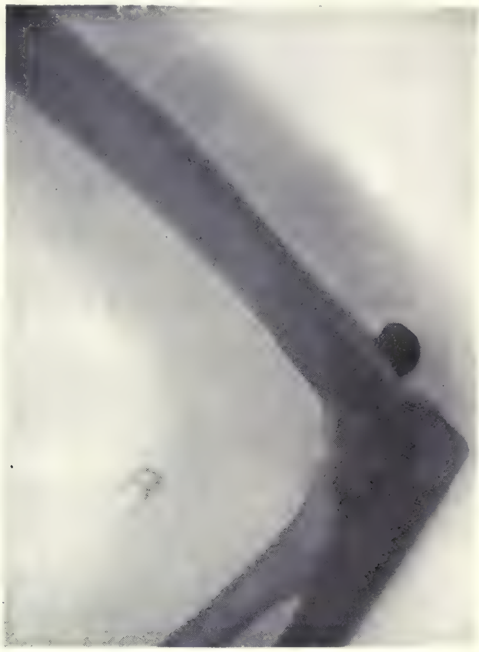


Fig. 2.—A Shrapnel Ball Flattened against the Shaft of the Humerus.

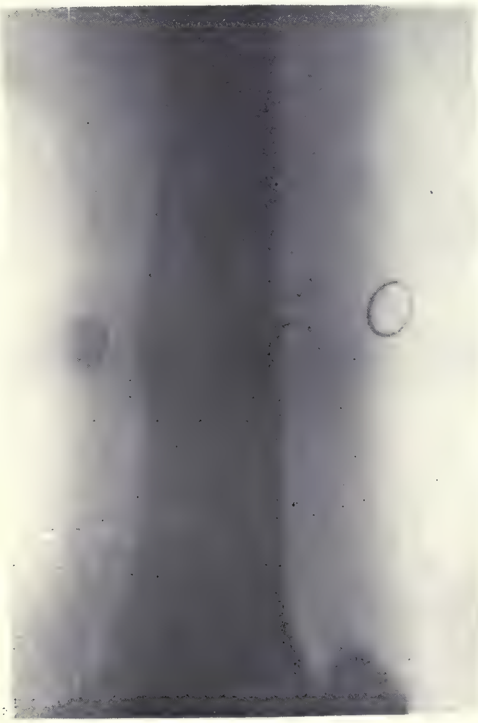


Fig. 3.—Shrapnel Ball Deformed by striking the Femur and broken into many small pieces. The Ring is placed at the Wound of Entry.

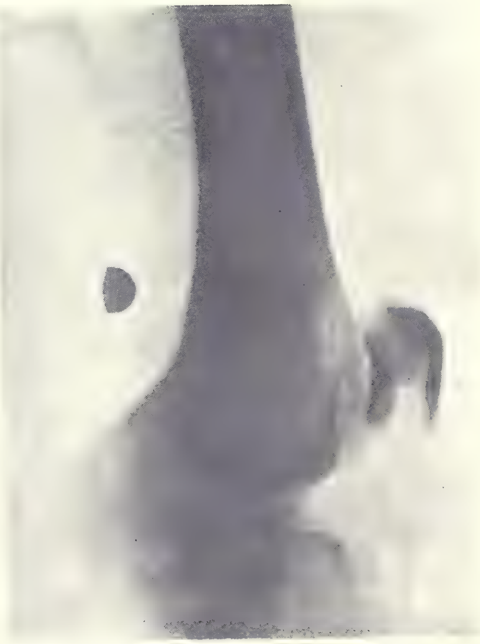


Fig. 4.—A Deformed Shrapnel Ball.

one entrance wound only, if the ball is entire, and the wound is rather characteristic.

If the ball has struck an external object before striking the patient, it may break into two or more pieces, and the wounds of entrance will then be multiple. When the ball passes into the body it remains there. Our experience has been that no shrapnel ball has passed through the body and come out at the other side, the way a bullet so frequently does. (Fig. 6.) When a shrapnel ball meets a bone it becomes deformed, according to the resistance offered by the bone, and some of the lead is left behind on or near the bone.

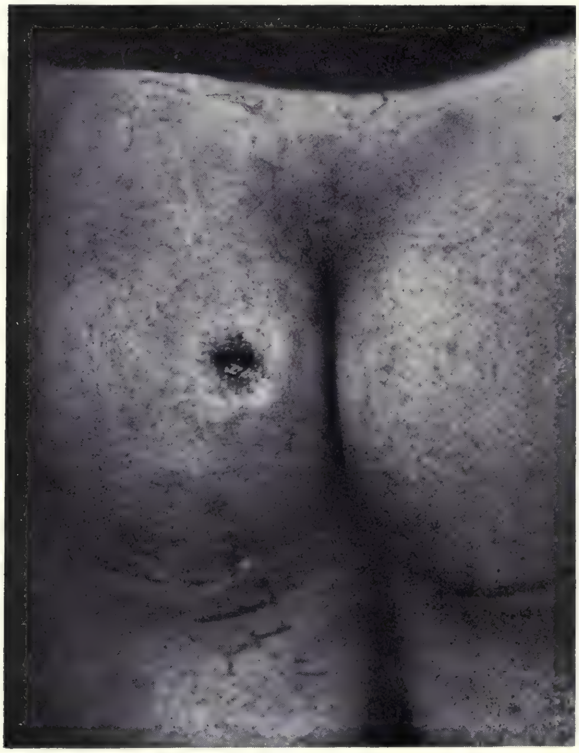


Fig 5..—Typical entrance wound of a Shrapnel Ball.

Shrapnel balls of iron have been found, but they are more commonly of lead.

Three different sizes of shrapnel ball have been found.

There are two bones only which, in our experience, a shrapnel ball cannot penetrate, viz., the femur in its shaft, and the vault of the skull. We have found several cases in which the femur has received a direct hit, and the ball has broken into two or more pieces, and just roughened the surface of the bone.

In one case a direct hit on the vault of the skull fractured the outer table and depressed the inner table, and the ball remained in the bone. We have had no case in which a shrapnel ball entered the brain.

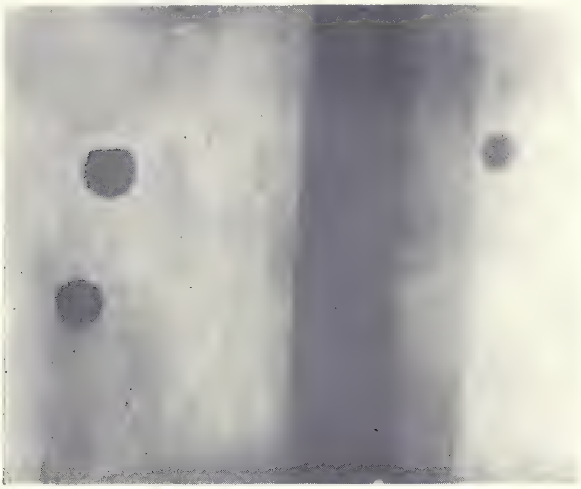


Fig. 6.—Three Shrapnel Balls lying near the Femur.

The presence of three indicates that the patient was near the shell when it burst and the balls had not time to spread. This shows how shrapnel balls enter and do not leave the body, as they have not sufficient force to pass through even with their initial bursting velocity.

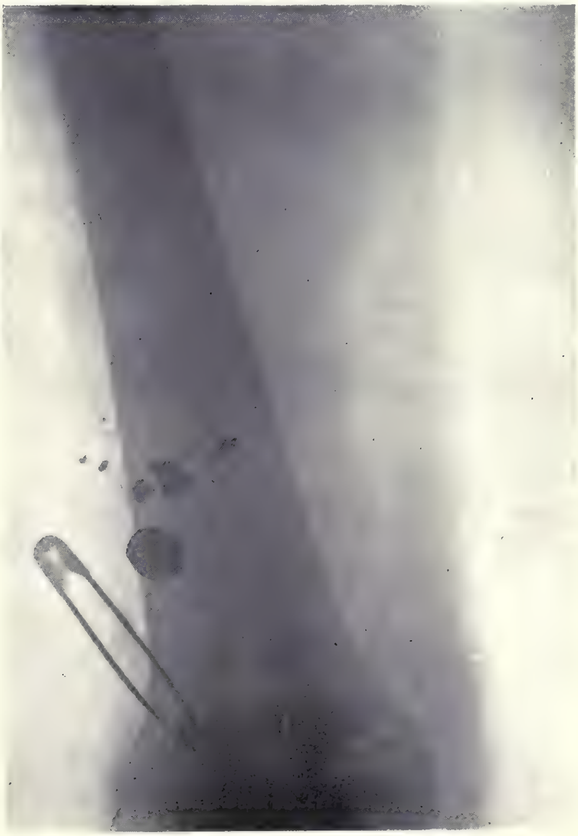


Fig. 7.—Femur struck by Shrapnel Ball, showing the power of the Femur to resist a direct hit.

The fibula and the bones of the forearm are always fractured by a direct hit, but the tibia may escape, as also may the humerus, but both humerus and tibia may be broken.

The small bones of the hand and foot, the ribs and the vertebræ are constantly fractured by a direct hit. The body of a vertebra may receive and lodge a shrapnel ball, and the X-ray may show very little damage to the bone.

When a shrapnel ball travels through the body without striking a bone, it is stopped by the skin far from its point of entry, and can be felt under the skin with the finger. The patient usually discovers it himself before it is confirmed by X rays.

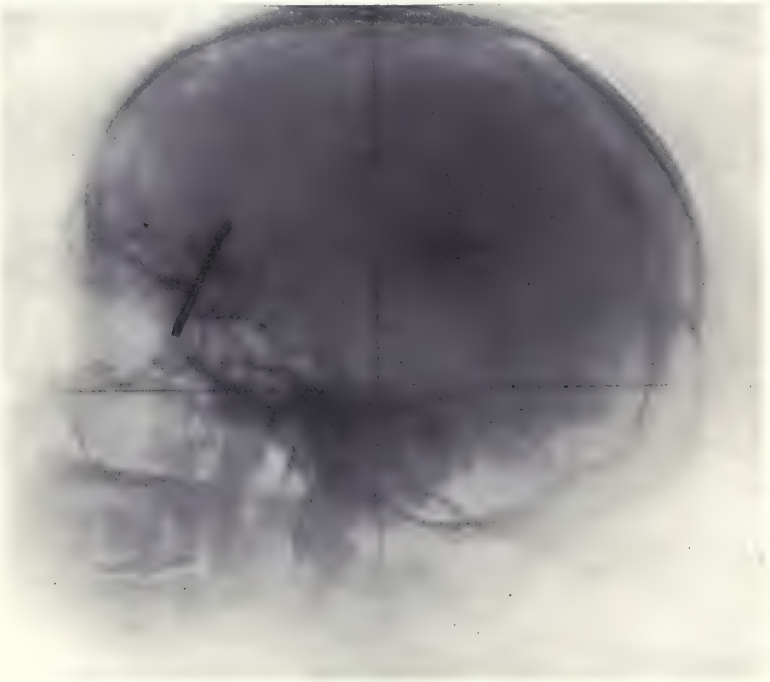


Fig. 8.—Shrapnel Ball lying in the Vault of the Skull, causing Depression of Inner Table and not entering the Brain.

It is sometimes difficult to distinguish a completely deformed shrapnel ball from a piece of iron casing of a shell, but the general rounded appearance of the lead and the want of serrated edges help to distinguish the two. When there are dust-like particles present, caused by the impact of the ball on a bone, there is no difficulty in diagnosing the deformed ball as a shrapnel ball.

The diagnosis of lead from iron by X rays becomes important where foreign bodies are removed by the help of an electro-magnet. The iron casing of shells and German bullets vibrate, but English bullets and the casing of Mills bombs do not vibrate when an electro-magnet supplied with alternating

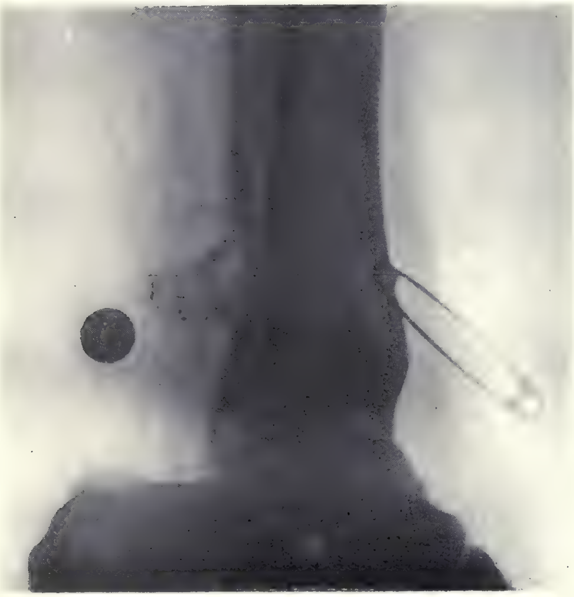


Fig. 9.—Showing Fibula broken by Shrapnel.

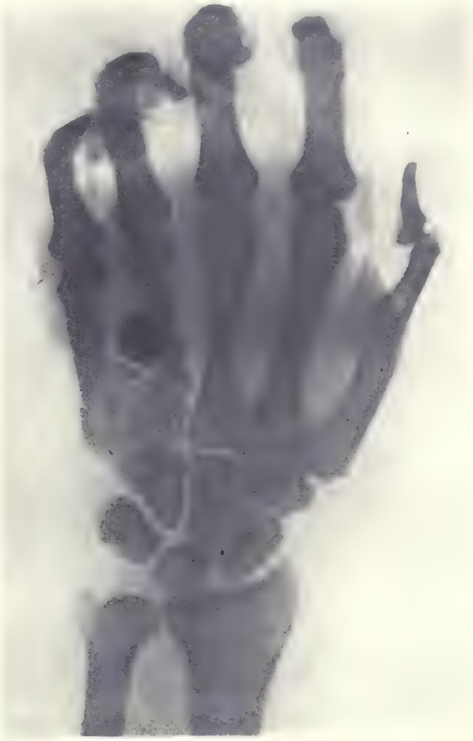


Fig. 10.—Showing the fourth and fifth Metacarpals broken by a Shrapnel Ball.

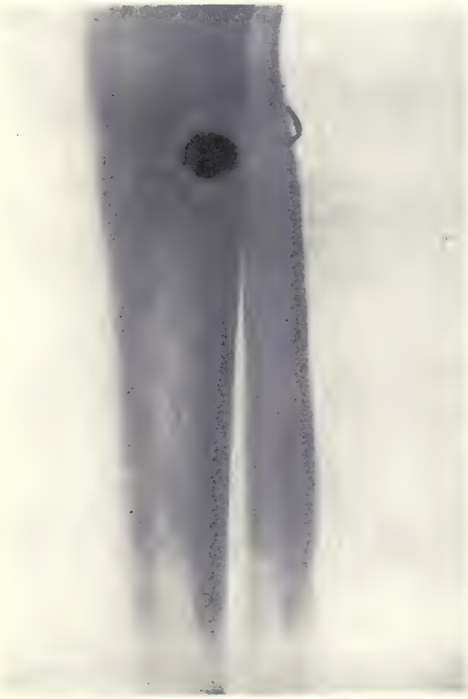


Fig. 11.—A direct hit by a Shrapnel Ball on the Tibia without a fracture of the Tibia.

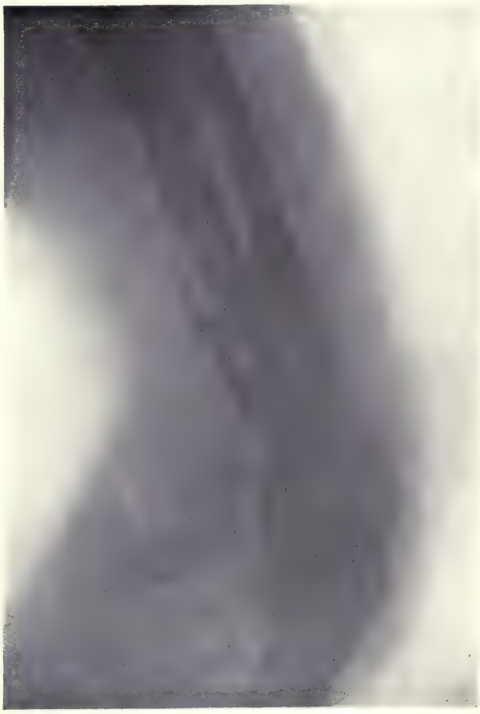


Fig. 12.—Humerus broken by Shrapnel Ball.

current is brought near to them. The finger, placed on the surface of the skin, can detect this vibration, and when it is too feeble to be felt, it can be heard by means of a curved wooden stethoscope.

The following characteristics help to distinguish a broken up shrapnel ball, a broken up bullet, and multiple foreign bodies of iron.

Table Showing the Characteristics of—

Shrapnel Ball Broken up.	Bullet Broken up.	Multiple Iron Foreign Bodies.
The edges are rounded, or slightly ragged, and not at all, or very slightly, serrated.	The larger pieces are very ragged.	The edges are serrated like broken cast iron.
One piece may show part of the round outline of the ball	One piece may show part of the form of the bullet.	Fragments not so numerous as a broken up ball or bullet.
Minute fragments like dust along the track of the ball.	Minute fragments like dust.	When numerous fragments are present they are more widely separated, and there are many separate wounds of entry. Absence of dust-like particles.

The contrast between the damage done by a bullet and that done by a shrapnel ball is very marked when a direct hit is made on the femur or on the skull. A bullet hitting the femur splinters the bone as it does a glass bottle. (Fig. 13.) At the same time the bullet breaks into pieces, and its fragments and those of the femur are scattered through the limb, or blown out through the skin, as if an explosion had taken place. This gives rise to the idea that an "explosive bullet" had been used, but the explosion is not due to any explosive like cordite inside the bullet, but to the manner in which it broke itself and the bone. In such a case the entrance wound is very small, and the exit wound very large (Fig. 14), whereas if the bullet had not struck the bone it would have passed through and have done very little damage, provided it missed large vessels and nerves. A spent bullet makes a larger exit wound than one with its initial velocity, as the latter keeps its course with its point leading, whereas a spent one turns round in the tissues and may emerge with its blunt end first. It may be difficult to say which is the entrance and which the exit wound when the bullet has its high initial velocity.

Just as the entrance through the skin may be very small, so the entrance wound into a bone may be quite small.

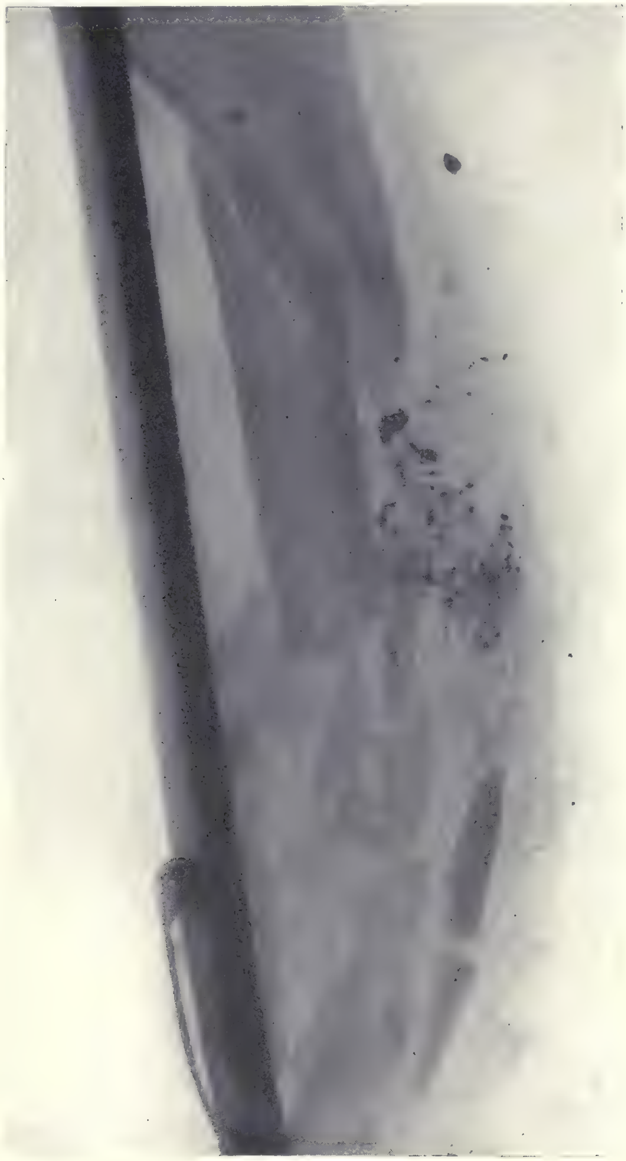


Fig. 13.—Showing the characteristic appearance caused by a direct hit of the Shaft of the Humerus by a Bullet. The casing of the bullet has passed on and the lead has remained *in situ*.

Fig. 15 shows a bullet which has penetrated into the femur, and its small entrance wound into the bone is shown faintly.

This bullet, instead of smashing the femur, changed its direction after entering the bone, and ran up the medulla, stopping in the cancellous bone near the great trochanter. This seems to show that the great splintering of a femur, when done by a bullet, takes place as the bullet emerges, and not as it enters the bone.

When a bullet goes through cancellous bone like the head of the femur, it may punch a clean hole and cause very little fracturing, but one of the worst fractures is caused when it hits the dense bone of the shaft near its junction with the cancellous bone. In this case the splinters of dense bone are driven into, and split up the cancellous bone to such an extent that amputation becomes necessary.

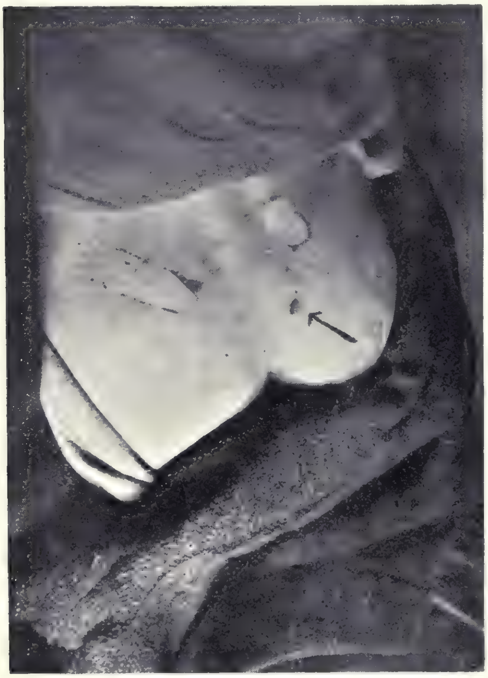


Fig. 14.—Typical entrance wound, two days old, of a Bullet.

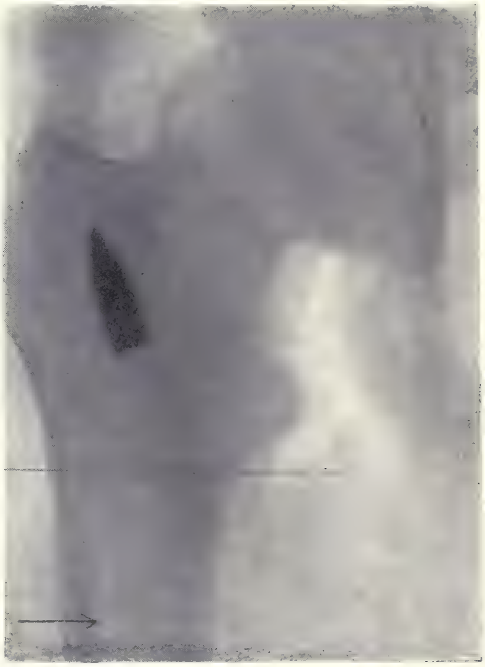


Fig. 15. Showing a Bullet which entered the Femur at the point to which the arrow is directed, then ran up the Medulla, and lies in the Cancellous Bone.

When a bullet travels through the soft tissues without striking bone, it usually lies with its pointed end directed towards the point of entry, though not pointing directly at the wound. This is a mechanical effect produced by the shape and balance of the bullet.

Quite a number of foreign bodies have been found in our series, viz., iron, nickel, lead, brass, pewter, copper, aluminium, oyster shell, chalk, stone, clothing, cartridges, foresight and backsight of a rifle, needles, barbed wire, buckles, screws, and pieces of machinery. Gas frequently forms from the dirt carried in with a foreign body, and it is very easily seen in an X-ray plate, and even on the fluorescent screen.

Analysis of a Series of 10,000 Plates, Showing Bullets, Shrapnel Balls, and Foreign Bodies, also Negative Findings.

Region.	Shrapnel Balls.	Bullets.	Foreign Bodies.	Negative Findings.
Abdomen	7	6	63	44
Ankle	8	1	93	303
Arm	9	19	300	247
Back	24	26	136	149
Buttock	20	13	320	162
Chest	19	41	302	194
Knee	28	11	307	284
Eye	0	0	41	18
Elbow	9	3	112	81
Forearm	4	4	210	89
Hand	5	6	194	164
Foot	5	6	115	186
Head	8	10	302	239
Leg	16	24	322	251
Back	7	13	94	64
Pelvis	7	8	31	55
Shoulder	31	24	212	203
Thigh	33	25	508	215
Wrist	1	2	54	45
TOTAL	241	242	3,716	2,993

REPORTS OF SOCIETIES.

RÖNTGEN SOCIETY.

The discussion on "The Future of the British X-Ray Industry," which was adjourned from the last meeting, was resumed at the meeting of the Röntgen Society on May 1st, when the President, Capt. Thurstan Holland, M.R.C.S., read the reopening paper.

Captain **Holland** said that the first step, in his view, must be an amalgamation of manufacturing interests. Our present X-ray firms were small, far too small to have any chance of success when competing with the large concerns found in Germany and America. It was only by having a large output in every possible line that it could be hoped to sell in competition and yet make fair profit. Our British firms as at present constituted might be large enough for the purely home market, but they would not even keep this unless they were able to capture the trade of our own colonies and some of the trade of foreign countries. The amalgamation of distributing firms and small manufacturing firms for the purpose of starting one great central workshop for the supply of the goods required was the first essential. The second point was the standardisation of apparatus. Let them take up any instrument maker's catalogue and they would find remarkable resemblances between it and other catalogues, both in designs and prices, save that a given piece of apparatus had some slight modification in construction which enabled a particular firm to label it with a distinctive name. It was a wasteful method of manufacture. Such of those pieces of apparatus as could with advantage be standardised should be made in one great workshop, where they could be more easily turned out in quantity by a smaller staff. The cost of production would be less and the advantage for trade would be obvious. Tube making he considered especially to furnish an object lesson in how not to do things. In a catalogue of one of the London firms of instrument makers, he counted 76 different tubes as listed and 18 different kinds of valve tubes. Every practical X-ray worker whose opinion was worth anything could reduce this list to, say, half a dozen tubes and two or three valve tubes. A reorganisation of the industry so that standardisation of apparatus and manufacture of tubes went hand in hand, and so that the best form of X-ray machine (coil or transformer) was combined with the best form of tube, would go far to lessen expense of production, to put a really workable instrumentation into the hands of medical men, and incidentally to improve X-ray work.

Passing from these two main points, Captain Holland proceeded to others, which, he said, were subsidiary, though at the same time helpful and necessary. The first of these was research work, and it was up against manufacturers to point out to research workers the line on which improvement was desirable. Expert workers were in a position to know the limitation and faults of the instruments they had to use. They were able to point out where alterations and improvements were desirable. Coils, transformers, and tubes had all undergone vast changes since the early days of X-ray work, but seemed to be capable of vast improvements still. In the next place it was well to consider the assistance which the average X-ray worker could give in this national effort. Up to the present the lack of teaching had been a very great drawback. There were a certain number—very few in reality—of sound, well informed radiologists in this country. The very large number of men who used X-ray apparatus knew little or nothing about it, or about the work they attempted to do with it. The education of radiologists from the technical point of view should be insisted on. He had not the slightest doubt but that in the future every medical student before he qualified would have to imbibe some knowledge of X-ray work and its possibilities, and, further, that everyone specialising in this branch of medical work would have to attend post-graduate courses of instruction and pass a special qualifying examination on the lines of, for example, the D.P.H. or of the diploma in Tropical Medicine. The present was the time for the leaders in this country to organise teaching, and press the claim for due recognition of this speciality. Captain Holland also advised that instead of showrooms full of odd bits of apparatus, the intending purchaser should be shown rooms with a complete installation set up, all in working order, with which the actual functioning of the apparatus could be demonstrated from first to last.

A tariff on goods coming into this country would be a sharp-edged sword, probably sharp on both edges. If by its means the manufacturers thought to bolster up inefficient goods, it would not work. Nothing would keep out better and more efficient apparatus, and the user would pay the extra for the best stuff. If, on the other hand, it was meant to put a stop to, or at any rate a drag upon, unfair methods of competition, then it might be of use. In conclusion, he dealt with the more general problem of the relation of the working man to so called capitalists and capital. Capital and labour should not be antagonistic, and the working man should be taken more into the confidence of his employers. If he (the speaker) were an employer of labour he would make it his business to consult with his men, explaining his objects and his difficulties He would try and make them understand that they were part and parcel of a going concern which would be carried on, not only from the point of view of the profit he was going to make, but also from the point of view of the living he was going to make out of it.

Dr. F. W. **Metcalfe** replied to Mr. Wright's attack on the medical profession at the previous meeting. Mr. Wright had said that they always went to the German for their apparatus;

the fact was that they went where they could get the best instruments constructed in order that they might do the best that was possible for their patients. As medical men they must not be carried away by the idea that it was their duty to bolster up British industry as against foreign industry, if in so doing they did not get the best means possible for curative treatment. As to the Snook apparatus, while he cast no reflection upon it as it was at present, up to the period of the war it was not so certain in its working as it might have been, and doctors might be forgiven for reflecting very seriously before they expended the large sum necessary to buy an instrument of that character. The speaker thought that there had been a certain lack of adaptability among British manufacturers. There was a certain hesitancy to give a client what he desired, apart from the prejudices and preferences of the trader. He also urged that catalogues should not merely be produced in the language of the country to which they were appealing, but that they should take cognisance of that country's weights and measures and monies. In conclusion, he urged as a great necessity the better technical education of assistants and apprentices. Those gentlemen who were connected with the industry should assist in founding a department in one or many of the technical colleges in this country, and see that their assistants and apprentices attended them and got some idea, not only as to research, but as to the best constructional procedures. He hardly thought the co-ordination of manufacturers feasible in an industry of this character, so far as the actual amalgamation of businesses was concerned, but he thought there might be co-operation in technical instruction and also in research.

Mr. P. J. **Neate** said that the German was patriotic all the time, but the Englishman was only patriotic when "riled" or stimulated. Rarely indeed did such patriotism extend to daily shopping or to the examination of competitive tenders. They had had in the past no British equivalent for *Deutschland über Alles*, and what would the future bring unless Parliament led the way? In reply to the questions set out in Mr. Pearce's original paper, he would suggest that (1) commercial remedies for the present condition of things were tariff reform, combination, and standardisation; (2) scientific remedies were the establishment of central research institutes with very able chiefs, well supported by individual outside helpers, willing to give freely *pro bono publico* in cash, brains, experience, or time, according to which predominated. There should be frank disclosure to this central institute of minor discoveries, failures, and requirements; also a recognised journal, edited at the central institute and supported by the trade, both in the way of communications and advertisements (the latter to the exclusion of all other forms of advertising except trade circulars); yet again there should be active support for more equitable patent legislation, especially in limiting the rights of foreign patentees to the rights given to British patentees in this country; and finally, there should be an extension of the foreign origins marks legislation so as to cover parts as well as aggregates.

Mr. F. W. **Higgins** said that research laboratories had been discussed by several speakers, but a point that ought not to be overlooked was the practicability of establishing small laboratories attached to each works. A suitably equipped laboratory could be got up at a small cost for experimental work in connection with a firm's own manufactures. He also thought that attention might be paid to non-medical applications of X rays. The medical aspect was at its maximum at the present time, and after the war there would be a very heavy fall in demand. It would be worth while, if possible, to extend the range of X-ray applicability, as, for instance, in the examination of metals.

Mr. A. E. **Dean** thought that the academic, the medical, and the technical men had all alike been found wanting in the very element which had made the German school so formidable, and that was Chauvinism. There had been *no concerted effort to create a British School of Radiology*. There was no better suited common ground for the starting of such a school *than the Röntgen Society*, and he strongly urged that a committee be formed to elaborate ways and means for laying its foundation. *There were still in existence the embers of such a British School.* Britain had shown the way in a few matters, and perhaps nowhere so strongly as in means of protection. The British methods of protecting radiolgists were appreciated by *France and America and Japan.* When the number of victims was at its highest the London Hospital was faced with the problem of providing protection for its staff or relinquishing X rays. What did they do? They asked for a scheme, if such were forthcoming, and boldly found what was then a big sum of money to provide four X-ray-proof cubicles, which had served as a prototype for the whole world, and a debt of gratitude was due to Lord Knutsford and his colleagues who voted the money and showed the way. How did British radiology find itself to-day cut off from its "spiritual home"? Had the work suffered? Or the Tommies? He had never seen finer work in any of the Berlin, Vienna, Hamburg and Freiburg hospitals than that produced in some of the clearing hospitals in France. Where did the apparatus come from to satisfy the enormous Army demand? From the works of the insignificant little British manufacturer. It was often abused, very often misused both by amateurs and experts, but it was carrying on, and the job was being done. Having proved that they could do useful work, let them put their house in order and endeavour by combined effort to do brilliant work. The keynote was not protective tariffs nor state aid, but Chauvinism. Let them lay their cards on the table and inaugurate a war exhibition of British radiology.

Mr. S. H. **Morphy** congratulated Mr. Pearce on raising a subject which was of such vital importance to everybody, and not alone to the doctors and manufacturers. He thought the first step in the way of constructive criticism would be to form some sort of co-operation between manufacturers, physicists, and doctors. He suggested that a committee be formed, combining representatives of these three classes, to thrash out the whole matter and outline the steps that should be taken by the Society. The following subjects required early attention:— (1) the drawing up of standard specifications for hospital outfits; (2) standardisation of tests and arrangements for carrying out these tests; (3) general publicity for X-ray work; (4) setting up an X-ray clinic; (5) encouragement of research and publication thereof. *The Röntgen Society was the proper body to carry out this work, as it combined all three points of view, that of the doctor, the physicist, and the manufacturer.* On the question of tariff reform, the speaker did not believe that this by itself would keep the industry in the front rank, but there was no doubt that owing to a scientific tariff the German manufacturers were enabled to avail themselves of a larger field for their goods, and therefore were able to manufacture on a large scale. British manufacturers must be able to manufacture on a large scale if they were to employ scientists and engineers of sufficient capacity to keep our instruments ahead of foreign countries. They would not gain or keep the trade unless their goods were at least equal to those of their foreign competitors. As to research, in the long run it seemed to him that every firm which was to be in the forefront must have its own research laboratory. This meant that firms must be considerably larger than those existing over here at the present time.

Mr. W. E. **Schall** said that he did not think the question of foreign competition need be feared very much for some years. Germany and Austria could not take up a position of prominent competition for several years owing to national feeling and possible prohibition to import; French firms would endeavour to compete, but their efforts were not likely to be as serious as those of America, and as to America, the trade there would be seriously hampered, so far as competition in the United Kingdom was concerned, by the question of freights and times of delivery, but this would only have a temporary operation, for freights would come down or *American factories would be started here.* The greatest danger, however, was that *the American School of Radiology might become so strong that the market would be attracted to America as it was to Germany before the war.* The only effective way to meet such competition was *for the British School of Radiology and Electrotherapeutics*, together with *its attendant industry*, to *achieve a reputation for excellence in all directions which would cause men from the colonies and from foreign countries to take cognisance of their work.* He thought it might be possible, under the ægis of *their Society*, for courses of lectures to be given, at any rate unless and until the medical schools and universities took the matter up. The lectures should cover the whole *field of physics and medicine so far as this was related to their speciality.* Out of this small beginning perhaps *an annual congress of X-ray workers might develop. The greatest result of such teaching would be the impetus it would give to original work. In his view a flourishing industry could only be the outcome of a strong and productive school of radiology, and the first step to take in this direction was to give facilities for study of the phenomena employed.*

The discussion was again adjourned to the meeting of the Society on June 5th.

THE RADIUM INSTITUTE, LONDON.

* *A Report of the Work carried out from January 1st, 1915, to December 31st, 1916.*

By A. E. Hayward Pinch, F.R.C.S.,
Medical Superintendent.

(Published with the Authority of the Committee.)

This report deals with the cases which have presented themselves at the Radium Institute from January 1st, 1915, to December 31st, 1916, inclusive—a period of two years. It was found impossible to issue a report at the end of 1915, many members of the staff being away on active service, and the time of those remaining being completely taken up by the clinical work of the Institute.

The character of this report is in many respects similar to that of those issued in 1913, 1914 and 1915, but the description of apparatus and technique has been omitted this year, as information on these points can be obtained by reference to the former reports.

The policy of declining to treat operable cases of malignant disease—rodent ulcer alone excepted—has been rigidly adhered to, save in those instances where the patient has positively refused to submit to operation.

The cases treated were in no instance selected, and the only ones refused were those in which the patients were practically moribund, or where the disease was of a kind for which radium therapy was manifestly unsuitable.

The term "apparent cure," used in relation to cases of malignant disease, must be interpreted as representing a condition in which all trace of the original lesion or lesions has disappeared, in which there is no sign of any recurrence, and in which the patient is, so far as can be determined by a thorough and careful examination, free from any indication or symptom of the disease.

Cases have been classed under the heading "improved" only when the result of treatment has been to produce a definite and marked degree of benefit, either in the direction of retardation of the progress of the disease, diminution in the size of a growth, healing of ulceration and arrest of hæmorrhage and discharge, or of relief to such subjective symptoms as itching, tenderness, pain, dyspnœa and dysphagia.

With reference to the figures appearing in the columns headed "Results not yet noted," and "Abandoned Treatment," it must be explained that in many instances it has proved impossible to obtain information concerning the patients treated, owing either to the absence of their medical man on military duties, or alteration in the patients' circumstances having caused them to depart to some other neighbourhood, and all trace of their movements being lost.

The strength of all the apparatus used in the treatment of cases is expressed in terms of hydrated radium bromide, a salt the radium element content of which is 53.6 per cent.

Table I.

Summary of Cases.

Examined, but not treated	87
Recently treated, and results not yet noted	123
Received prophylactic irradiation only	33
Apparently cured	172
Cured	52
Improved	498
Not improved	215
Abandoned treatment	144
Dead	76
	1,400

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* Abridged form, reprinted with permission from the Radium Institute.

TABLE II.

Classification of Cases.

Disease.	Examined, but not treated.	Result not yet noted.	Received prophylactic treatment only.	Apparently cured.	Cured.	Improved.	Not improved.	Abandoned treatment.	Dead.	Total.
Carcinoma, Squamous-celled:										
Glabrous skin	1	4	1	5	—	4	6	6	2	29
Buccal, oral, lingual, and pharyngeal mucous membranes	14	4	6	4	—	25	13	30	16	112
Œsophagus ...	3	4	—	—		1	1	3	3	15
Larynx	1	2	—	—		—	5	4	4	16
Vagina	—	1	—	4		1	1		—	7
Vulva	—	1	—	—		—	1	3	1	6
Uterus	6	6	—	1	—	34	13	23	10	93
Penis	1	—	1	—		—	—	—	—	2
Bladder ...	1	—		—	—	1	1	—	—	3
Urethra ...	—	—		1		—	—		—	1
Carcinoma, Spheroidal-celled:										
Breast	8	17	12	6	—	67	24	24	14	172
Liver and gall bladder ...	—	—	—	—	—	—	1	1	2	4
Thyroid ...	—	—	—	—	—	1	—	—	1	2
Pancreas ...	—	—		—	—	1	—	—	—	1
Paget's disease	2	—	—	—	—	1	—	—	—	3
Carcinoma, Columnar-celled:										
Large intestine	4	1	1	—	—	3	2	—	—	11
Rectum ...	4	6	—	—	—	33	10	14	8	75
Stomach ...	—	2	—	—	—	—	—	—	—	2
Ovary	—	1	—	—	—	—	4	—	—	5
Prostate ...	—	2	—	—	—	2	1	1	—	6
Kidney and suprarenal gland... ...	—	1	—	—	—	1	—	—	—	2
Parotid ...	—	—	—	—	—	1		—	—	1
Rodent ulcer ...	—	10	1	122	—	37	8	6	2	186
Sarcomata:										
Spindle-celled	2	—	4	1	—	10	13	4	1	35
Round-celled	3	3	1	1	—	5	6	6	1	26
Melanotic ...	—	—	—	1	—	—	1	—	—	2
Myelosarcoma	—	—	—	—	—	—	—	1	1	2
Lymphosarcoma	—	—	—	2	—	2	—	7	2	13
Osteosarcoma	—	—	—	—	—	—	1	—	—	1
Endothelioma	—	—		—	—	2	—	3	1	6
Lymphadenoma	1	2	—	2	—	16	1	1	—	23
Malignant glands	2	2	1	1	—	5	8	2	3	24
Parotid tumour	—	2	3	—	—	4	—	—	—	9
Abdominal tumour ...	1	1	—	—	—	—	—	—	1	3
Mediastinal tumour ...	—	2	—	—	—	3	—	1	2	8
Villous tumour of bladder ...	—	—		—	—	2	—	—	—	2
Glioma	—	—	1	—	—	—	2	—	—	3
Enchondroma	1	—	—	—		—	—		—	1
Cystic disease ovary	—	—	—		—		3	—	—	3
Adenoma (thyroid) ...	3	—	—	—	—	5	1	—	—	9
Fibromata ...	—	—	—	—	—	1	—	—	—	1
Fibroid disease of uterus ...	1	—	—	1	—	3	2	—	—	7
Leucoplakia ...	—	—	—	1	—	2	—	—	—	3
Naevi:										
Capillary ...	—	4		—	8	17	3			32
Cavernous ...	1	1	—	—	8	16	5	—	—	31
Moles, warts and papillomata	1	4	1	—	24	12	1	1	—	44
Tuberculosis:										
Glands	—	1	—	—	—	1	—	—	—	2
Skin	1	1	—	6	—	18	2	—	—	28
Mucous membrane ...	—	—	—	2	—	3	—	1	—	6
Spring catarrh	—	—	—	1	—	1	—	—	—	2
Trachoma ...	—	—	—	—	—	1	—		—	1
Chronic inflammations ...	3	3	—	—	—	4	3	—	—	13
Chronic ulcerations	4	2	—	—	—	1	1	—	—	8
Chronic endometritis... ...	1	1	—	2	—	1	—	1		6
Skin diseases:										
Keloid and vicious cicatrices...	2	6	—	—	9	24	1	—	—	42
Lupus erythematosus	—	1	—	1	—	6	—	—	—	8
Psoriasis ...	1	1	—	—	—	2	—	—	—	4
Pruritus ...	—	1	—	3	—	8	—	—	—	12
Chronic eczema ...	—	—	—	—	3	2	—			5
Lichenification of skin	—	1	—	—	—	2	—	—	—	3
Roentgen-ray dermatitis	—	—	—	—	—	2	—	—	—	2
Lichen planus	—	—	—	—	—	1	—		—	1
Leucodermia	—	—	—	—	—	—	1	—	—	1
Sclerodermia	—	—	—	—	—	1	1	—	—	2
Sycosis ...	—	—	—	2	—	1	—	—	—	3
Xerodermia pigmentosum	—	—	—	—		2	—	—	—	2
Xanthelasma	—	—	—	—		1	—	—	—	1
Fordyce's disease ...	—	—	—	1	—	1	—	—	—	2
Rhinophyma	—	—	—	—	—	1	—	—	—	1
Urticaria ...	—	—	—	—	—	—	1	—	—	1
General diseases:										
Disseminated sclerosis ...	—	—	—	—	—	2	2	—	—	4
Exophthalmic goitre	—	—	—	—	—	2	—	—	—	2
Neurasthenia	2	—	—	—	—	—	2	—	—	4
Neuritis ...	1	3	—	—	—	2	4	—	—	10
Neuralgia ...	—	1	—	—	—	1	—	—	—	2
Gout	—	2	—	—	—	2	3	1	—	8
Rheumatism	2	2	—	—	—	7	2	—	—	13
Arthritis deformans	5	14	—	—	—	77	50	—	1	147
Angio-neurotic œdema	—	—	—	—	—	—	1	—	—	1
Diabetes ...	—	—	—	—	—	1	—	—	—	1
Dupuytren's contraction	—	—	—	1	—	—	1	—	—	2
Raynaud's disease ...	—	—	—	—	—	—	1	—	—	1
Splenic anæmia	—	—	—	—	—	1	—	—	—	1
Tinnitus ...	—	—	—	—	—	—	1	—	—	1
Abdominal adhesions	—	—	—	—	—	1	—	—	—	1
Various ...	4	—	—	—	—	—	—	—	—	4
Totals ...	87	123	33	172	52	498	215	144	76	1,400

THE TREATMENT OF DISEASE.

CARCINOMATA.

Squamous Celled (Epitheliomata).

The results obtained in the treatment of small epitheliomata affecting glabrous surfaces are encouraging, and when operative measures have been declined, heavy dosage with powerful unscreened applicators affords a reasonable chance of success.

Epitheliomata of the buccal, laryngeal and pharyngeal mucous membranes still prove very troublesome, and though temporary improvement frequently follows on radium treatment, the final result is usually disappointing.

In some rare instances isolated nodules in the tongue respond well to the burying within their substance of a tiny powerful emanation tube of 50 mgr. or more initial activity, screened with 1 mm. of silver or 0.3 mm. of platinum, for a period of eighteen to twenty-four hours. A brisk reaction occurs, followed by fibrous changes in the nodule, and arrest of the disease. Small and circumscribed growths occurring in the soft palate do comparatively well under this method of treatment, and may be regarded as the most suitable of all epitheliomatous lesions in the mouth and fauces, for radium therapy.

Primary epitheliomata affecting the vaginal mucosa usually react satisfactorily to prolonged exposures with powerful applicators heavily screened, and if of recent origin and without much surrounding induration are often completely removed.

Carcinoma of the Uterus.

The symptomatic improvement which almost invariably follows upon the radium treatment of inoperable cases of this disease is most striking, and far exceeds that of any other therapeutic measures. Arrest of hæmorrhage, lessening of discharge, healing of ulceration, reduction of surrounding infiltration, diminution of the rate of growth, and amelioration of pain are constantly observed, and in some instances cases previously declared to be inoperable become operable. When the disease is confined to the cervix, and the growth is of the fungating type, a preliminary curetting of the ulcerated mass is advisable.

The best results are obtained by the introduction of a 50-mgr. or 100-mgr. tube, screened with 2 mm. of lead and 3 mm. of rubber, into the cervical canal, or if this be impracticable, into the posterior fornix; a powerful flat applicator, containing 80 mgr. to 100 mgr., screened in similar fashion, being placed on the abdominal wall over the fundus uteri. The exposure should be from thirty to sixty hours' duration, spaced over from five to ten days.

The treatment should be repeated at intervals of six weeks or two months. In very susceptible patients a slight degree of vaginitis is sometimes seen, and on this account the patient should be instructed to use a vaginal douche night and morning, to prevent the possible formation of adhesions.

Carcinoma of the Rectum.

Patients suffering from this disease vary very greatly in their response to radium treatment, and the results are by no means constant or uniform. Speaking in general terms, the cases which do best are those occurring in patients over fifty years of age, and in which the growth is annular in type, vascular in character, and situate in the upper half of the rectum. The plaque-like growth, with much surrounding infiltration, is but rarely improved, and owing to the difficulty of shielding the adjacent healthy mucous membrane from the action of the radium rays, proctitis generally occurs, and is very troublesome.

Many patients apply for radium treatment in the hope of postponing or averting the operation of colostomy. If the growth be annular, vascular and exuberant, with a tortuous and much constricted lumen, radium treatment will often relieve the threatened obstruction.

The introduction of a powerful radium tube actually within the lumen of the growth serves first to dilate the stricture mechanically, and the reaction when it occurs produces some degree of avascularization, and shrinking of the more prominent portions of the tumour, thus widening the canal. When the growth is of a spongy character these effects may be observed to follow after each of three or four or more courses of treatment given at intervals of two or three or four months.

Sooner or later, however, fibroid contraction of the lumen will occur, necessitating the performance of colostomy, or regular dilatation of the stricture, either digitally or with bougies.

When the growth is of considerable extent, and ulceration is present, the performance of colostomy before radium treatment is commenced is strongly to be advocated, as the constant passage of fæces over an ulcerated surface that is reacting to radium is productive of great pain. When the tumour is situate at the recto-sigmoid junction, the presence of a colostomy aperture also enables the upper portion of the growth to be treated with a tube passed down the sigmoid through the lower colostomy opening.

The routine method of treatment consists of a thirty-hour exposure—five days of six hours each—with a tube containing 100 mgr., screened with 2 mm. of lead and 3 mm. of rubber, and applied within the lumen of the growth, the series of exposures being repeated at the end of six or eight weeks.

When the disease affects the recto-sigmoid junction a flat applicator, containing 80 to 100 mgr. screened in similar fashion is applied over the inner part of the left iliac fossa.

Some amount of proctitis is generally noted about a week or ten days after the termination of the treatment, and though it usually proves but slight and transient, in susceptible subjects —more especially in men—it is sometimes exceedingly severe, and occasions the patient much pain and discomfort, which may persist for four or six weeks.

(*To be continued.*)

NOTES AND ABSTRACTS.

ELECTROTHERAPY.

The Treatment of Hysterical Phenomena by "Intensive Re-education." — Clovis Vincent (*Archives d'Electricité Médicale*, 411, Dec., 1916.)—The man with a functional disability, who requires this procedure, is he who believes himself incapable of exercising will power in the required direction and must be compelled to exert it; then alone will he be capable of the voluntary effort. This method makes use of a strong galvanic current to stimulate and encourage the will power, and, as carried out at the neurological centre at Tours, consists of three stages. The first—now notorious under the description of "torpedoing," which was first applied to it by the patients—utilizes a direct current of 35 ma. and 70 volts, applied to the infirm limb or lumbar region by two electrodes of about 3 centimetres diameter. These are placed close together, to shorten the course of the current, which is applied for fractions of a minute at short intervals. The whole thing may last up to 10 minutes in an obstinate case.

At first a small current is used; this is gradually increased, and when it becomes really painful the patient may object quite vigorously. Then comes a moment when he yields and begins to perform the required movement of his own volition.

The second stage immediately follows, and consists of suitable exercises and movements designed to restore the normal automaticism. Time must not be given for him to slip back into his former state. When the new condition is won, it remains to be consolidated, as the patient is still a potential hysteric and capable of relapse. He now undergoes a rational course of training to build up his moral and normal self-confidence.

The essentials for the method are that the doctor should be a good neurologist, full of confidence in his success, of strong will and strong muscles, for he must be sure of his diagnosis in all its aspects, and be able to enforce his will on the patient, who may resist mentally and physically. The preliminary examination must be complete, and any doubt must go in favour of the patient. No man with an organic lesion should be subjected to the "torpedo" process if there is any possiblity of injury or failure. It is only suitable for the functional condition; besides, of course, for malingering.

The results of work at Tours are good, even in cases of many months standing. Only 3 per cent. have been failures, while men have been returned to duty, cured, during 1916, at the rate of 600 in a year. If the method were systematically practised throughout France this would be equivalent to two divisions of infantry from the whole country.

N. B.

RADIOTHERAPY.

Actinotherapy in Dermatology.—J. Belot and L. Nahan (*Jour. de Radiol. et d'Elect.*, Nov., 1916, p. 365).—After much experience in the use of ultra-violet light in dermatology, the authors find that it is to be recommended for cases of lichen simplex, lichen planus, and some types of chronic scaly eczema and seborrhœic eczema. For such conditions as these, where only a surface effect is desired, unfiltered rays are used, and the patient some distance from the mercury vapour lamp. By using the rays filtered through uviol glass, and with compression of the skin, good results are obtained in cases of flat vascular nævi, and very appreciable improvement in some cases of lupus erythematosus. For lupus vulgaris, the authors think that this method of treatment should be given up in favour of the Finsen light or of radiotherapy.

R. W. A. S.

PHYSIOTHERAPY.

The Treatment of Hydrarthrosis of the Knee by Physiotherapy. — A. Laquerriere (*Jour. de Radiol. et d'Elect.*, Nov., 1916, p. 353).—In treating hydrarthrosis of this joint, the author states that the following three factors must be carefully borne in mind, the effusion, the arthritis, and the muscular atrophy, and while employing the various physical methods in treatment, two dangers must be guarded against, fatigue of the muscle and injury to the articulation. Particularly with wounded soldiers, one ought either to forbid walking or to take into account in treatment the extra fatigue which it entails.

The author has seen want of success from a treatment carried out in too dilatory a fashion, or insufficiently supervised, or from other causes, such as the climate. Unsuccessful results are in others due to the presence of a refractory reflex atrophy, whose mechanism and electrical reactions are not as yet fully understood, or to the presence of grave articular lesions, the result of the primary injury, or developed slowly in the course of a chronic effusion into the joint.

R. W. A. S.

RADIO-DIAGNOSIS.

On the Tolerance of the Body to Foreign Bodies.—Guilleminot and Dogny (*Jour. de Radiol. et d'Elect.*, Nov. 1916, p. 389).—The authors classify their cases under three heads. In the first they place the cases of large foreign bodies in a region easily examined and not causing any clinical symptoms.

In the second are cases of foreign bodies in delicate and complex organs such as the liver, heart, lung, intestinal wall, certain parts of the brain, and not interfering with the functions of these organs.

In the third group are the cases of numerous splinters in any situation and causing no functional interference.

The authors describe several cases under the first two groups which show how tolerant the body may be to a foreign body.

Under the third group they say that everyone agrees that foreign bodies in the soft tissues are tolerated very well in many cases, unless near a nerve trunk or a part subject to constant pressure, or where movements cause friction of the splinter against bone or muscle. Under such conditions the foreign body acts like an irritating point.

The authors point out that a foreign body may be overlooked in parts easily examined or tolerated by the body, even when a complex organ with delicate functions is involved. No one can, however, state that such cases as a foreign body inside the brain, myocardium, or liver, will remain so, although a good number of cases have been recorded where such tolerance has remained for a long time splendid, and apparently even become permanent.

They also urge the necessity of systematic radiographic examination of all the wounded, not only of the injured part, but also of the neighbouring regions, even in cases where the entrance and exit wounds are evident.

R. W. A. S.

A Supernumerary Bone of the Foot (Os Vesalii).—Laquerriere and Drevon (*Jour. de Radiol. et d'Elect.*, Nov. 1916, p. 395).—Congenital bony abnormalities are of two kinds: (*a*) some bones have not a definitely constant form, *e.g.*, the scaphoid of the wrist and the posterior part of the astragalus show varying forms, other bones, as the sesamoids, may or may not be present, those at the metatarso-phalangeal joint of the great toe being almost constant, while at the same joint of the little toe they are rare; (*b*) others are true abnormalities due to either an arrest of development during fœtal life or to the reversion to an ancestral type.

Under true abnormalities, anatomists have for long described the following supernumerary bones of the foot:—

(1) Os trigonum, situated behind the astragalus and between the os calcis and the tibia (described by Rosenmuller in 1804).

(2) Os tibiale externum, behind the scaphoid, with which it may articulate or be joined completely or incompletely, causing the appearance of a fracture (Bauhin, 1605).

(3) Os peroneum, just below the external border of the cuboid (Vesalius, 1555).

(4) Os Vesalii.

(5) Supernumerary calcaneum, in the space bounded by the head of the astragalus, the cuboid, and the calcaneum (Stiéda, the elder, 1869). This bone seems to have been described also under the name of accessory cuboid, and leads to confusion with the os peroneum, called by Froelich "supernumerary cuboid."

(6) Os uncinatum, on the plantar surface of the external cuneiform.

(7) Internal cuneiform, longitudinally divided.

(8) Intermetatarsal bone, between the internal cuneiform and the second metatarsal.

Radiographically, these can be divided into two groups; the first three are relatively common, the last five are rare, almost curiosities. Lilienfeld has once seen the intermetatarsal bone in both feet, and the same observer has once found the os uncinatum. It is because some of these bones are so rare that the authors have drawn attention to them here in order to avoid errors of interpretation.

They describe two cases of bilateral abnormality not producing any symptoms, and consisting of a considerable enlargement of the base of the fifth metatarsal, slightly bending under the cuboid, and of the presence of an extra bone, large in one of the cases, continuing backwards the tuberosity of the metatarsal and separated from it by a space On account of the great enlargement of the base of the metatarsal, the authors think that this extra bone should not be regarded as an ununited posterior epiphysis, but from its shape and the radiographic appearance of the articulation, as a true supernumerary bone, an os Vesalii. They admit that in rare cases there is at the base of the fifth metatarsal an epiphysial point, which does not unite, but at other times a true supernumerary bone, which is not epiphysial.

The authors think that it is by dissection, and not radiography alone, that the proper interpretation will be given, and that it is to anatomists to whom we must look for the solution of such problems.

R. W. A. S.

Roentgen Diagnosis of Bronchiectasis.—A. B. Moore (*American Journal of Roentgenology*, Nov., 1916, p. 524).—The article is based on a series of twenty-five cases, studied by combined clinical and radiographic methods, by the author.

In discussing the ætiology he considers the inflammatory changes in acute bronchitis, and the atrophic changes in the elastic and muscle fibres in the chronic form, may lower the resistance of the bronchial tubes sufficiently to render them unable to stand the strain of any increased pressure. These changes are most common in broncho-pneumonia and bronchitis resulting from whooping-cough, measles, influenza and fevers. The importance of broncho-pneumonia in particular, he thinks, cannot be too strongly emphasised. Cough is probably the most important factor in bronchiectasis, although retention of secretion, such as when the bronchus is plugged by a foreign body, must also be regarded as of considerable importance. It is highly probable that both foreign bodies and enlarged bronchial glands produce this condition more by the associated cough than by the local obstruction. Another factor to be considered is traction on the bronchi and bronchioles due to indurative or cirrhotic changes, such as occur in tuberculosis, syphilis, and other infections. It seems, however, probable that bronchiectasis results more frequently from a combination of these causes than from any one alone. Poor hygienic surroundings apparently exert a marked influence, few cases being found in patients living under conditions of proper hygiene. Although the work of Smith and others has established the importance of the b. influenzæ in bronchiectasis, in the majority of the author's cases the infection was mixed

Moore classifies the radiographic appearance into three types: the infiltrative, the cylindrical, and the sacculated. These three forms most probably represent different stages in the disease, and demonstrate the existence of gross changes that have been proved by pathologists.

The infiltration type appears as a more or less stringy increase in density along the course of the bronchi, usually localised to the lower pulmonary lobes, and radiating out from the hilus to the periphery of the chest and extending into the costophrenic angle. In the earlier stages this infiltration is not particularly marked, and differs little from that seen in chronic bronchitis or other irritative conditions of the bronchial tract, except that the process is usually more localised, is found nearly always at the base of the lung, and the bands of increased density extend to the periphery of the chest. It is probable that this stage corresponds to the clinical stage in which drainage is effective and there is relatively little retention of secretion. This type presents the chief difficulties to the radiologist, and in many cases it is impossible to make an unqualified diagnosis.

The infiltrative stage is followed by the cylindrical type. There is the characteristic mottled increase in density, extending outward along the course of the bronchi, producing a more or less fan-shaped shadow. The density is usually greatest near the hilus, and, distributed throughout this density, one or more small areas of diminished density may be located. These areas are more or less clearly circumscribed, and are produced by the so-called pseudo-cavitations of bronchiectasis, which are dilated bronchioles that have been emptied of their secretions. The visualization of these cavitations depends largely on the ability of the patient to empty the bronchi of secretion, and their presence is pathognomic of the disease. Consequently, a doubtful diagnosis is often made certain by a second radiographic examination after the patient has brought up as much of the secretions as possible. This is most easily done by the patient coughing while in the Trendelenburg position, face down. It is the fan-shaped increase in density along the course of the bronchi, and the localization of one or more of these pseudo-cavitations, that make the X-ray diagnosis of the cylindrical type practically certain. The possibility of the process being hidden by a superimposed heart shadow must, however, be borne in mind.

The sacculated type is characterised by the localization of distinct pseudo-cavitations surrounded by dense fibrous tissue. These cavitations are practically always multiple and larger than those encountered in the last type. They vary in size from that of a bean to that of a walnut and have a thin wall. The section of a lung involved by this type very strongly resembles a bunch of grapes cut through the centre. The fibrous tissue surrounding these groups of sacculations is very dense and often feels like cartilage. It may be so dense, and the cavitations so filled with secretion, that the shadow is almost homogeneous and the diagnosis difficult. The true condition, however, is usually revealed by emptying the cavities.

Thickening of the pleura, either parietal or visceral, is rather uncommon, except in those cases in which a previous thoracotomy has been performed, and it is only in such cases that any marked distortion or limitation in the movement of the diaphragm is seen. However, in cases of long standing, particularly those of the sacculated type, the heart and mediastinal structures are often drawn to the affected side by the contraction of fibrous tissue.

Moore thinks the most common conditions from which bronchiectasis must be differentiated radiographically are chronic purulent bronchitis and lung abscess.

It may be differentiated, he says, from chronic bronchitis by the greater increase in density along the bronchial trunks in bronchiectasis, the tendency to localise at the bases of the lungs, the extension of this increased density to the periphery of the chest, even as far as the costophrenic angle, and the presence of bronchiectatic pseudo-cavitation or sacculation. Bronchiectasis is usually differentiated without difficulty from abscess of the lung by its location and the fact that the walls of its cavity are relatively thin and small. The cavities are multiple and there is absence of a fluid level in them.

Having thus described the radiographic appearances, the author analyses the clinical symptoms that were present in his cases.

R. W. A. S.

RADIOLOGY.

Roentgenology of the Heart.—A.W. Crane (*American Journal of Roentgenology*, Nov., 1916, p. 513).—The following description of the terms used in this branch of radiology is given. The roentgen tracing of the heart means, to most medical readers, a tracing of its outline by an orthodiagraph. The roentgenocardiogram, however, is a tracing of the heart beat obtained by covering the heart with strips of sheet lead, so arranged that a narrow slit, usually about 2 cm., in the lead can be adjusted over the pulsating margin of the cardiac shadow as seen on the screen. Several of these slits can be adjusted simultaneously over different areas of the pulsating heart, the aorta, and the pulmonary vein. A photographic film on a screen in a cassette is then made to travel at a given speed, usually about 5 cm. per second, transversely over these slits, while the roentgen ray is turned on. The result is a tracing which is similar to and comparable with a sphygmogram, a polygram, or an electrocardiogram.

In the latter we deal with the electrical changes in the heart; in the sphygmogram or polygram we deal with pressure variations within the blood vessels (excepting in the case of the apex beat); but in the roentgenocardiogram we deal directly with the movements of the heart muscle. The electrocardiogram is stated to give a record of both auricles contracting as a unit and of both ventricles contracting as a unit. The sphygmogram or polygram gives records of the venous pulse and the left ventricle. But the roentgenocardiogram is capable of giving a separate record of the muscle movements of each chamber of the heart. In this respect it stands unrivalled.

The author describes the apparatus used for his own observations, and also the essentials for a properly constructed apparatus for taking roentgenocardiograms.

He considers the essential points in the X-ray examination to be (1) the detection of dilatation or hypertrophy of certain chambers of the heart; (2) the character of the pulse of various heart chambers; and (3) synchronism of different chambers.

The disadvantages of the roentgenocardiograph are stated to be:—

(1) Very large, heavy patients offer resistance to the passage of X rays. This is overcome by using wider slits, a slower movement of the carriage, and a ray of higher penetration.

(2) Some patients with cardiac disease cannot lie in the horizontal position. This can be overcome by the sitting position, in which the patient is placed with the back against the lead screen of the cardiograph and with the tube in front. Each slit must then be adjusted over an interspace between ribs, and special pains must be taken to immobilize the patient.

(3) Patients with advanced tuberculosis, pneumonia, or pleuritic or pericardial effusions, are not suitable for roentgen tracings, because the cardiac outline is obscured or actually concealed. Dense deposits at the hilum of the lung running downward along the heart border usually are an advantage rather than otherwise, because there is a narrow clear space between the heart and these deposits which improves the tracings.

The X-ray appearances seen in each of the valvular diseases of the heart are described in detail, but, as the author aptly says, the combined lesions of two or more valves, which are extremely common, greatly increases the complexity, not only of the clinical diagnosis but also of the radiographic.

Just as Holzknecht has instituted symptom complexes in gastric radiology, so has Crane condensed cardiac radiography into sign and symptom complexes for the most frequent diseases, and their formula is given.

He also describes various less frequent and more recently discovered cardiac conditions, which may or may not present definite radiographic appearances, such as auricular flutter, heartblock, etc.

The article is illustrated with photographs of the necessary apparatus and the tracings obtained by it.

R. W. A. S.

Practical Points on the Use of Intensifying Screens, and on their Selection and Care.—H. Threlkeld-Edwards (*American Journal of Roentgenology*, Dec. 1916, p. 585).—After some years study of this subject the author finds that the intensifying screen renders its greatest value and service, not in shortening the time of exposure in deep thoracic abdominal cases with bismuth-filled viscera, using a high vacuum tube in which the discharge of a great milliamperage of current is instantaneously made sufficient to produce the roentgen image, but in making it possible to make studies of any part of the body with a tube of such low vacuum that perfect detail will be produced in the negative without either danger to the patient by trophic injury to the skin, or spoiling of the radiograph by secondary radiation fog.

He has got better results, with superior detail and greater clarity, by using a single and very fast screen, especially made with a large percentage of the fluorescent salt, passing the rays through the film only.

Theoretically, it does not seem desirable to pass the rays through a layer of such an opaque mineral salt as calcium tungstate, and he has never found it advantageous to do so, except in the case of slow screens, which contain little of the fluorescent salt.

A screen cannot be expected to give good service if it is manipulated in the dark room, when developing solutions are exposed in open trays. The author advises the use of a separate dust-proof dark room, or closet, where the exposed screen negative should be transferred from the cassette to a light-proof envelope, or box, for subsequent development in the developing room.

Dirt is given as the sole cause of "slowing down" of screens. Good screens should retain their fluorescent luminescence indefinitely if properly treated and carefully protected from dust and dirt, from contamination by dirty fingers, splashing of developer solution, and especially from contact with chemically dirty photographic plates. The last three are chiefly responsible for screen deterioration and "slowing down" after the first hundred pictures are made.

The emulsion surface of a screen is perfectly waterproof and may be cleaned with a damp cloth or mop of absorbent cotton when necessary, using a small quantity of fine chalk powder, or other abrasive, if very dirty.

R. W. A. S.

PUBLICATIONS RECEIVED.

Books.

Roentgen Diagnosis of Diseases of the Alimentary Tract. By Carman and Miller. Philadelphia and London: W. B. Saunders Co.

The Treatment of War Wounds. By W. W. Keen, M.D., LL.D. Philadelphia and London: W. B. Saunders Co.

Journals.

American Journal of Roentgenology, August, 1917.

American Medicine, July, August, 1917.

Archives de Electricité Médicale et de Physiotherapie, August, 1917.

Boston Medical and Surgical Journal, August 16th, 23rd, 30th, 1917.

Bulletin of the Johns Hopkins Hospital, August, 1917.

Cleveland Medical Journal, August, 1917.

Journals—*continued.*

Gaceta Médica Catalana, August 31st, September 15th, 1917.

Good Health, September, 1917.

Medical Journal of Australia, June 30th, July 7th, 14th, 21st, 1917.

New York Medical Journal, August 18th, 25th, September 8th, 1917.

New York State Journal of Medicine, August, 1917.

Norsk Magazin for Lægevidenskaben, September, 1917.

Pacific Medical Journal, August, September, 1917.

Policlinico, Il., August 15th, 1917.

Proceedings of the Royal Society of Medicine, July, 1917.

Southern Medical Journal, August, 1917.

Ugeskrift for Læger, August 9th, 16th, 1917.

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IN COLLABORATION WITH

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THE CONTRACTION FORMS OF THE HUMAN STOMACH ILLUSTRATED BY PLASTICINE MODELS.*

By GEOFFREY JEFFERSON, M.S. Lond., F.R.C.S. Victoria, B.C.

It is a well known fact that the human stomach as seen at operation, at post-mortem, in the dissecting room, and in the X-ray room presents many marked differences in its appearance. In the first three instances the stomach itself is seen, in the last instance merely its shadow, a skiagram. That is to say that in the condition in which a view of the stomach would be most profitable to us, the stomach being alive and in normal action, we have to content ourselves with a silhouette in lieu of the organ itself. No one has seen, or is likely to see, with the naked eye the normal human stomach in action. It is rarely exposed by operation unless its anatomy and physiology are deranged, and even then the view obtained is necessarily incomplete, peristalsis is usually absent, and muscle tone is diminished by the anæsthetic. This being the case it seemed to me that models of the active normal human stomach fashioned from skiagrams would be helpful in the elucidation of some points in the anatomy of the stomach. One would have a replica of the

* Models shown before the Victoria Medical Society, February, 1916.

stomach as it is in life, its surface indented by peristaltic waves and functional contractures. Models were accordingly made in the manner described below. It was then found that comparison would be facilitated if some of the more famous stomachs described by anatomists were reproduced in the same form. The stomachs described by His (12) require no such transformation, as he illustrated his paper with photographs not of the stomachs themselves but of plaster casts of the organ and some of its neighbouring viscera.

Method of Making the Models.

(*a*) *The Roentgenographical Models.*—As the basis of models showing the living, active stomach, Figs. 2, 5, and 8 of the Kaestle, Rieder, Rosenthal (6) series of "roentgen-kinematograph" pictures were taken. These figures show the progress of the peristaltic wave very clearly and have been widely accepted as standard silhouettes of the normal contraction phases of the human stomach. The outlines of these radiograms were enlarged by photography (in order to ensure accuracy) up to a uniform length of five inches. These outlines were now traced on to cardboard and cut out. The patterns thus obtained were made the basis of "Plasticine" models, the cardboard being embedded in the middle of this material and then modelled by the fingers to a finish. The models were finally painted "flat" white and mounted on stands.* The œsophagus is not, of course, shown in the radiograms but has been put on in the modelling. The margin of error in such a procedure is small. The first inch or so of the duodenum has also been added for the sake of completeness. The position and direction of this in the models differs from that given in most anatomical diagrams, and requires, perhaps, a word of explanation. The beginning of the duodenum can be seen in only one (*i.e.*, 6) of the twelve "bio-roentgenograms" of Kaestle, Rieder, and Rosenthal, from which the models were made. This one figure was, however, enough to give me the plane and orientation of the pylorus. The twist and turn over backwards into the sagittal plane is based on the many beautiful roentgenograms of the pylorus and duodenum which Cole (1) in particular, and many others in general, have published. Owing to this backward turn of the duodenum in its first, supra-papillary (14) portion, one sees this part of the gut in X rays end on. This is the explanation of the characteristic but peculiar shape of the so-called duodenal "cap." The angle at which the models are mounted is 60° with the horizontal, sloping downwards and forwards. This angle was obtained as an average from three skiagrams (see Fig. 4). Very few of these illuminating lateral views are in existence; Försell (3) shows some half-dozen and de Quervain (8) about three. The thickness of the models varies somewhat in different places. Valuable guidance in the modelling was received from a study of the lateral views just referred to. On an average the thickness of the stomach, antero-posteriorly, is about one-sixth

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* After enamelling or varnishing "Plasticine" models can be freely handled without damage to them.

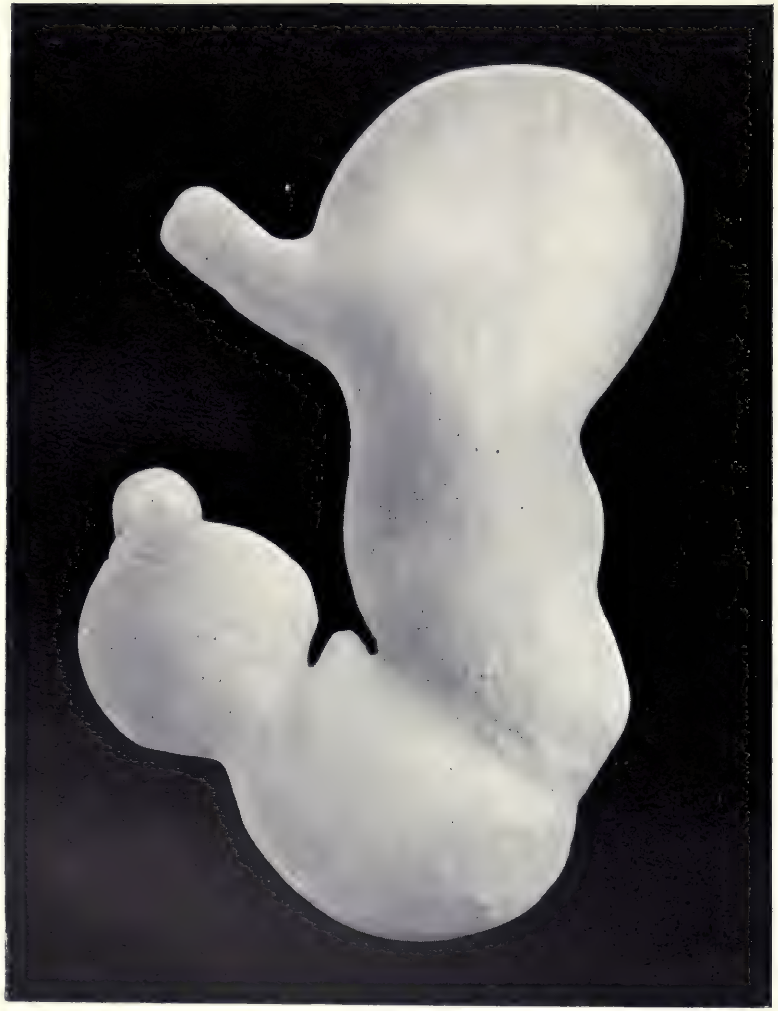

Fig. 1.—Model of active human stomach from skiagram (Phase 2, Kaestle, Rieder, Rosenthal series). Stomach exhibits two peristaltic waves and two tonic indentations of greater curvature of body. Note direction of duodenum.

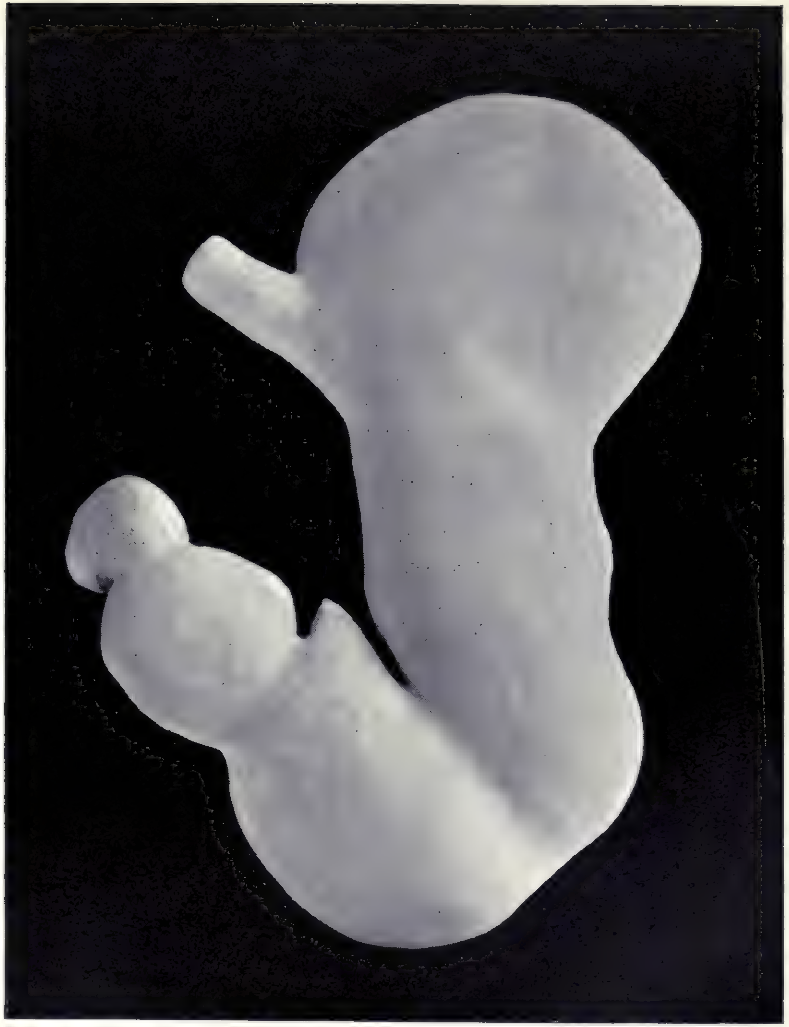

Fig. 2.—Model of active human stomach from diagrams. (Phase 5, same series). Peristaltic waves progress. Tonic indentations of greater curvature slightly changed.

Plate 4.

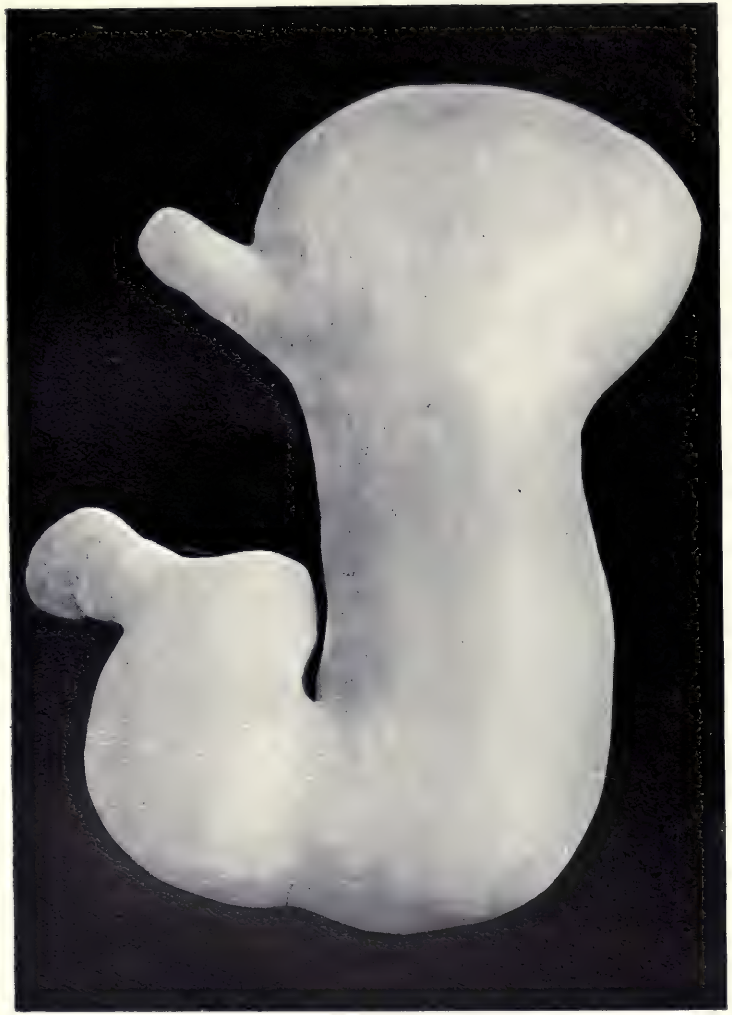

Fig. 3.—Model of active human stomach from skiagram. (Phase 8, same series). Second peristaltic wave nearing pylorus; tonic indentations of greater curvature relaxed.

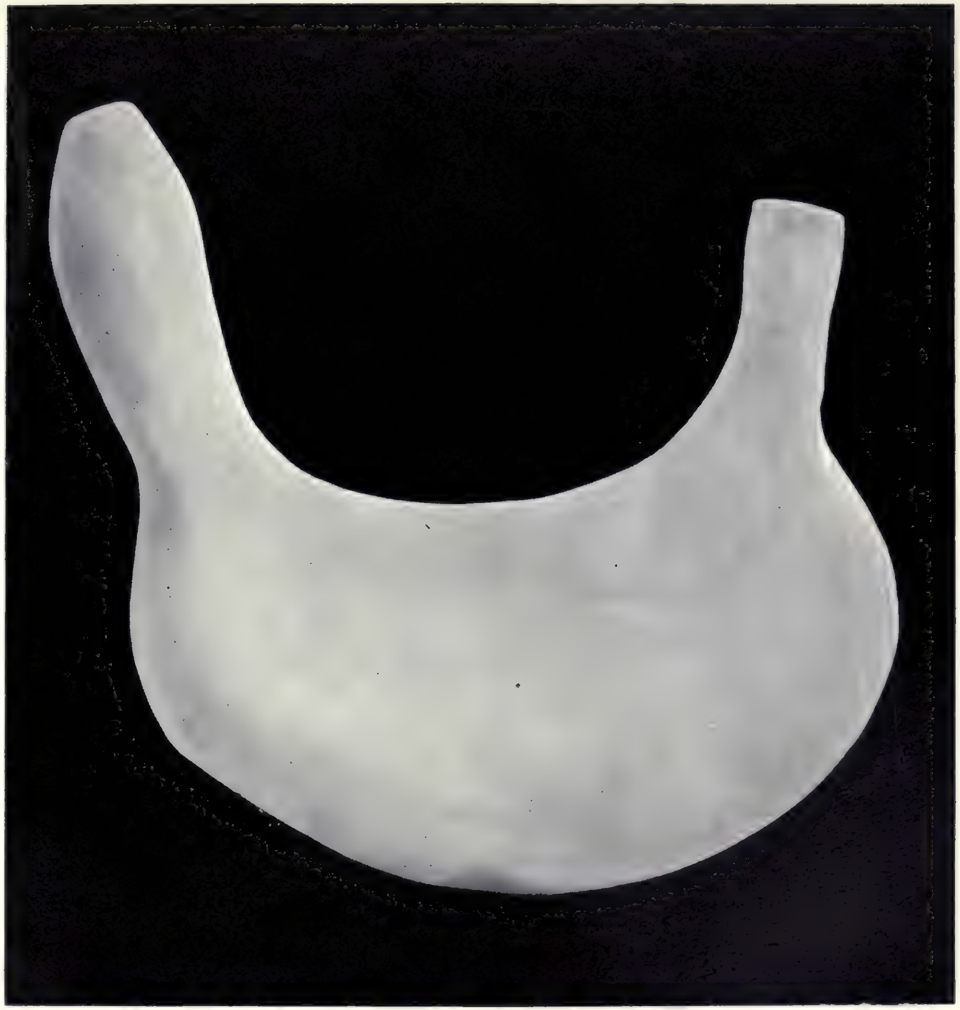

Fig. 5.—Model of human stomach, made from diagram of T. Willis's (Anno 1682). Note horizontal lie of stomach and absence of indentations and contractures.

Plate 5.

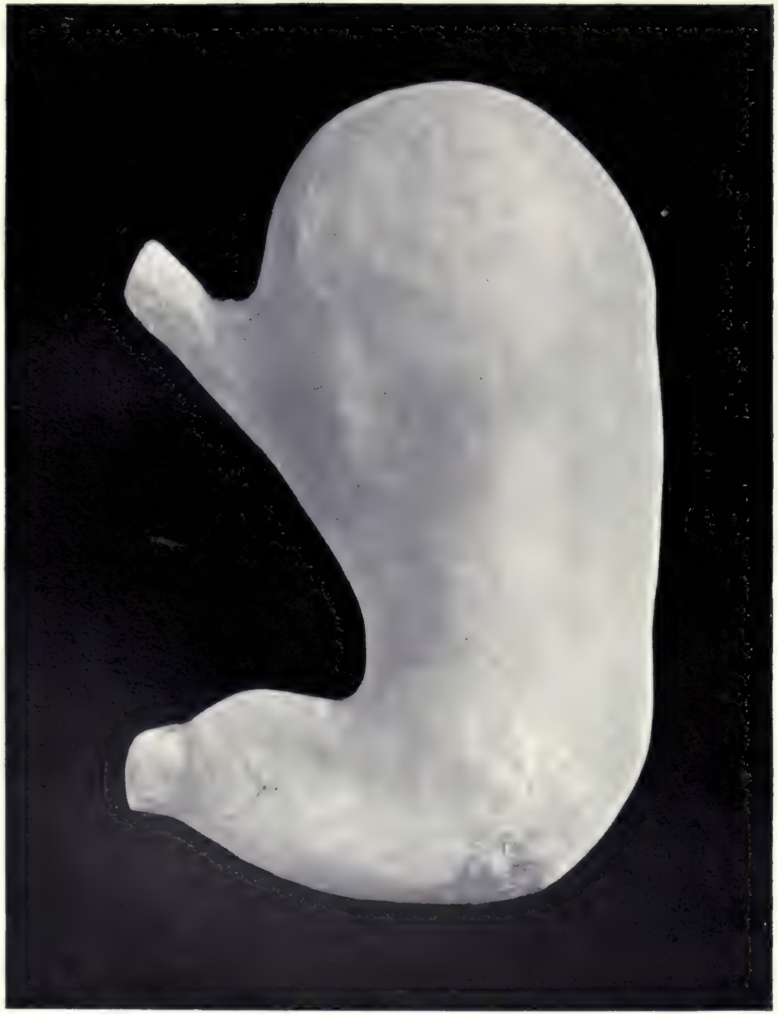

Fig. 6.—Model of human stomach made from diagram of Jonnesco's. Vertical lie of stomach correct, but differs from Figs. 1, 2, and 3 in absence of signs of muscular activity.

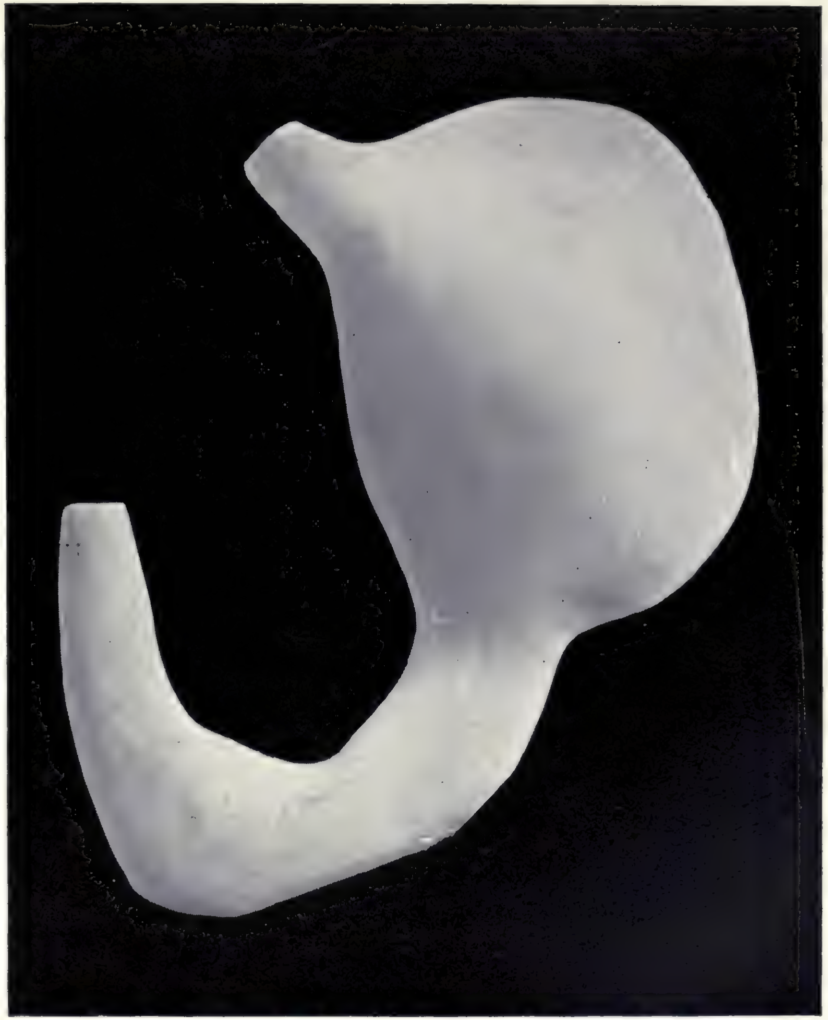

Fig. 7.—Model of stomach made from diagram of Cunningham's. Pyloric musculature has contracted strongly, in contrast with pars cardiaca. Form not commonly met with except after formalin injection.

Plate 6.

of its total height from pole to pole. The only parts of the stomach which approach the spherical are those parts of the pars pylorica which lie distal to a powerful peristaltic wave. In the modelling no wave was considered a true peristaltic wave unless both curvatures of the stomach were indented. The depth to which the surface modelling of such waves should be carried was gauged from the depth of the indentations of the curvatures.

(*b*) *The Anatomists' Stomach Models.*—Having thus obtained models of the stomach as it is in life and in action, it was necessary, as has been said, to make models of the stomachs which have been figured by the great authorities on gastric morphology. For this purpose several stomachs were taken. The first selected was that of Willis (11) representing a conception of the viscus which had great fame in its time and influenced teaching for close on 200 years. In contrast with this the stomachs figured more recently by Jonnesco (7), by Cunningham (2), by Birmingham, and by Waterston were also modelled. The models were made as before with "Plasticine," but without embedded cardboard patterns. The stomach was enlarged with a camera lucida to five inches in length and this outline was used as a control, the modelling being checked by careful measurements. These models were then cast in plaster.* Three of these models are reproduced here, Figs. 5, 6, and 7, representing the stomachs figured by Willis (11) (*loc. cit.*, Tabula III), by Jonnesco (*loc. cit.*, Fig. 117), and by Cunningham (*loc. cit.*, Pl. 3, Fig. 23). These models

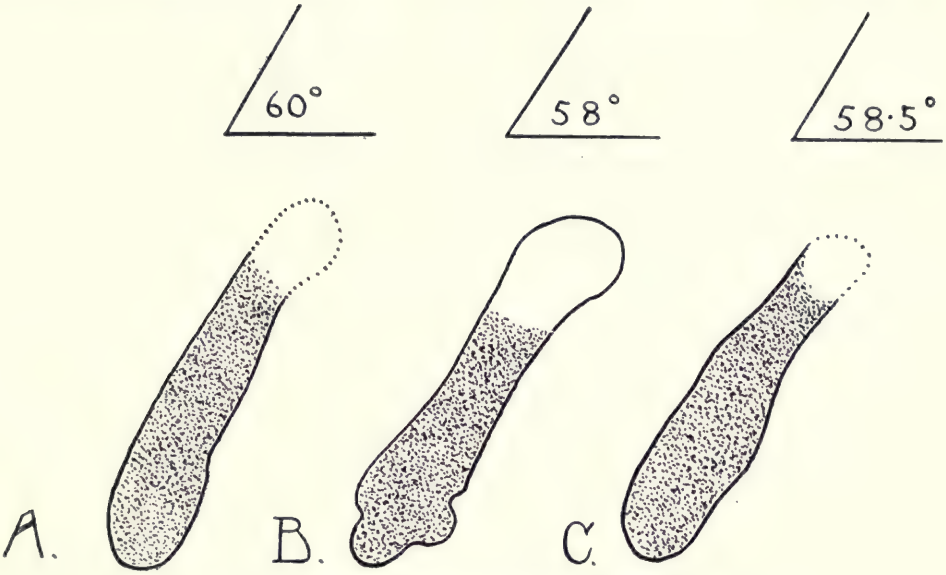

Fig. 4.—Schema of three stomachs seen from the side.
A. Modified from de Quervain.
B. Modified from Förssell.
C. Author's stomach, taken by Dr. Stanier, Victoria, B.C.
Note the backward tilt of the fundus.

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* The method employed for the making of the roentgenographical models illustrated here was the later evolved and the better. There is no advantage in the plaster cast unless the model is likely to be carelessly handled by a number of people.

represent the stomach at rest, free from peristaltic waves. Such a condition must be rare in life, even when the stomach is empty, for the sensation of hunger has been shown to be due to peristalsis.

DISCUSSION OF THE MODELS.

Turning first to the latter series of models, which I have called "the anatomists' stomach models." These represent the stomach at rest, dead. Fig. 5 is a model of the stomach according to Willis. It is an early conception, long before the question of the orientation of the organ has aroused special attention. The horizontal lie of the stomach, which is suspended like a bag from fixed points at cardia and pylorus, is very striking and very incorrect, but was accepted with slight modifications until comparatively recent times. The stomach here is a flaccid, inert bag. Fig. 6, a model of the very famous stomach described by Jonnesco (7) differs from the preceding mainly in its orientation, the long axis being vertical. This is a much truer picture of the stomach than is Willis's. Both of these models represent the viscus about three-quarters filled and quite free from indentations save that Jonnesco figures a slight groove at the junction of stomach and duodenum (*sillon duodéno-pylorique*). Fig. 7, a model of one of Cunningham's (2) best known specimens, presents contrasts with both of the preceding specimens. It is a partly emptied stomach, in which the pyloric portion has almost completely contracted, causing the organ to be divided into two easily differentiated portions, which Cunningham called "cardiac sac" and "gastric tube." The contraction has involved the whole of the pyloric musculature, and this almost equally, reducing the distal part of the stomach to the form of a veritable tube with a diameter somewhat larger than a piece of small intestine. Stopford (9) has published a photograph of an excellent stomach of this type, an intestine-like stomach with a slight dilatation at its proximal or cardiac end. Such markedly tubular stomachs are rare findings, except in formalin-injected bodies, although the empty stomach in life probably contracts and approaches this form. The musculature of the pyloric portion of the stomach is certainly more irritable than that of the cardiac portion, and this property it seems to retain for some time after death (10). The indentations and spasms, which one rather rarely meets with at the ordinary hospital post-mortem, are much more commonly found in the formalin-injected body. The contractures may be single or multiple, and if single and at the middle of the stomach produce a condition closely resembling spasmodic hour-glass stomach. Waterston (10) has shown that these contractures are artifacts directly due to the injection of formalin, and he has watched the condition come about as the formalin was run in. These spasms do not represent, as some have supposed, "fixed" peristaltic waves. The true peristaltic wave is narrow, deep, and rarely single, whilst the formalin spasm is wider and shallower and often single. Nor, in my own experience,* are contractions often found in the stomach removed at post-mortem and simply immersed in formaldehyde solution, a more intimate association between the chemical and the muscle appearing to be necessary. In summing up these models one sees that one only, namely Cunningham's, presents any alteration in configuration which can possibly be put down to physiological activity. The contraction which the pyloric portion of this specimen has undergone may well represent the later stages of the emptying of the stomach, but the organ is, of course, devoid of peristaltic waves. The danger of mistaking localised indentations due to formalin injection for persistent or "fixed" peristaltic waves has been emphasised above.

Turning now to the roentgenographical models, Figs. 1, 2, and 3 represent the filled normal stomach, digestion and emptying being in full swing. The subject was in the upright posture, the long axis of the stomach vertical. These models in general configuration resemble the stomach of Jonnesco, Fig. 6, save that the simple outline of the latter is in the models made irregular by peristaltic waves. It will be noted that the upper, cardiac part of the stomach, in Figs. 1, 2, and 3 presents no striking differences from the same part of the stomachs of Jonnesco and of Cunningham, that is to say, that this part of the stomach presents only slight evidences of activity. There is here no wave which encircles the whole stomach indenting both curvatures, and in the absence of such double or complete indentation one is safe in declaring that no peristaltic wave is present. It is true that the lower part of the greater curvature of the cardiac portion presents certain marked indentations, but these are not present on the lesser curvature. Indeed, the comparative immobility of the lesser curvature of the pars cardiaca during gastric digestion is a striking fact, to which I have drawn attention previously (4). The differences in muscular structure between the two curvatures account for their different behaviour, the oblique muscle being able to affect the greater curvature, whilst it is powerless to alter the lesser. The most marked differences between the two sets of models are found, as one might expect, in the part of the stomach which is normally most active, *i.e.* the pars pylorica. In Figs. 1, 2, and 3 two peristaltic waves can be seen coursing over the viscus. The wave passes much faster along the greater curvature than along the lesser, where it remains practically stationary at the so-called incisura angularis. The wave swings pendulum-like round the lower pole of the organ, and having accomplished this it progresses steadily forward towards the pylorus, the wave moving at an equal pace on both greater and lesser curvatures till the pylorus is reached. It is in this part of its course that the wave resembles a true "ring-wave" (the *ring-welle* of German writers). The typical gastric peristaltic wave thus progresses differently in the two parts of its course, and closely resembles the typical intestinal wave only in the part of the stomach distal to the incisura angularis. As the pars pylorica is a cone

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*** Of thirty stomachs removed at post-mortem none showed any indentation or contraction, nor was any produced by subsequent immersion in formalin solution.**

with its base to the left and apex to the right the wave becomes narrower as it progresses.

The irritability of the pyloric as compared with the cardiac musculature has already been mentioned. One naturally wishes to define an exact and definite spot where this change occurs, where the irritability first appears. Anatomically this should be where the cardiac musculature ends, that is, at the lower insertion of the musculus obliquus (4). Radiographically, the origin of the peristaltic wave is approximately at this spot, but this origin is capable of a proximal variation, even in the same individual. Posture has some effect upon this. A stomach exhibiting a "two-cycle" peristalsis (Holtzkneckt) will often change to the "three-cycle" type if the recumbent posture is assumed. And it is common knowledge that peristaltic waves rarely begin from the fundus in the upright posture, but are not uncommonly seen arising there if the subject is lying down. So that it is difficult to make any hard and fast rule with regard to the origin of peristalsis and the muscular structure of the stomach. Posture may, therefore, change the form of the stomach, not only passively, but by causing variations in its activity.

It is tempting to suppose that the musculature of the middle of the stomach, where the peristaltic wave originates, possesses a very special irritability, a readiness to contract and originate rhythmical contractions—that it is, in fact, to the stomach what the sinus venosus is to the heart. Such a local irritability would account for the alleged presence of the so-called "middle sphincter" (H. M. W. Gray). So far, however, no definite neuro-muscular mechanism has been discovered here (*e.g.*, see Keith (5)).

The Incisura Angularis.—This series of models illustrates very clearly the changing form of the incisura angularis—the variations wrought in it by the muscular activity of the stomach wall (*cp.* Figs. 1 and 6). This leads one to consider the nature of the incisura angularis, and one is forced to conclude that it is the outcome of several factors :—

(1) It is a preformed element in the stomach structure, that is to say, that all stomachs, even when cut away from their attachments and dissected, present an angulation on the lesser curvature where the pars pylorica joins the pars cardiaca. This angle is wide and obtuse.

(2) The incisura is capable of variation by the manner in which the stomach is slung from the œsophagus and duodeno-pyloric junction (*vide* His's models, *loc. cit.*).

(3) The incisura is capable of variation by the manner in which the stomach is supported. This is a corollary of the preceding factor, but is probably more important. In gastroptosis and visceroptosis, where the stomach tends to hang from its attachments, the angulation on the lesser curvature becomes very acute.

(4) The distribution of the arteries and nerves, particularly the latter (13), hold the pars pylorica up and cause a certain amount of angulation here over and above the anatomical structural angulation. After the removal of the

pad of fat, vessels, and nerves from the lesser curvature, the pars pylorica always makes a more obtuse angle where it joins the pars cardiaca than it did before such dissection.

(5) Over and above these factors changing the incisura angularis is the variation produced by the intrinsic muscular activity of the stomach wall. The peristaltic waves which indent it cause it to assume widely differing forms (*cp.* Figs. 1, 2, 3, and 6).

In conclusion, then, the shape of the incisura angularis and its degree of angulation depends on several factors capable, each in its degree, of causing much variation.

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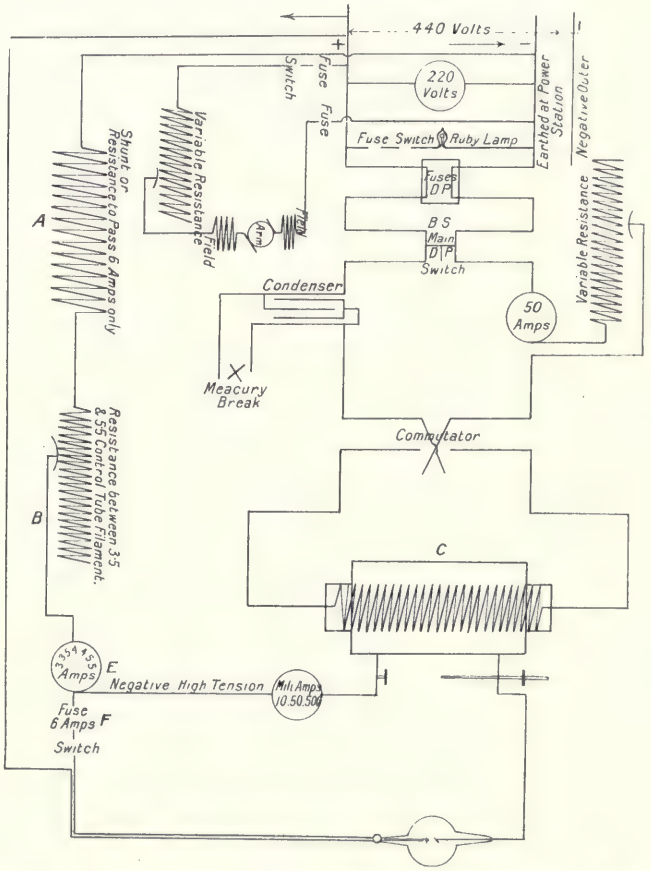
A METHOD OF RUNNING THE COOLIDGE TUBE ON CONTINUOUS CURRENT MAINS, WITHOUT THE AID OF ACCUMULATORS OR OTHER TRANSFORMING DEVICE.

By **Francis Hernaman-Johnson**, M.D., Consulting Radiologist, Aldershot Command, etc.

In the Archives of Radiology and Electrotherapy, for August, 1917, Drs. Shorten and Barnard describe their method of running a Coolidge Tube with the negative pole of the coil earthed. This has the effect of rendering the negative side of the tube "dead" in so far as the possibility of shocks is concerned, and enables the accumulator controls to be freely handled without any special insulation. Their paper is concerned with the question of the suppression of inverse current, and with increasing the convenience of the Coolidge Tube on the existing accumulator systems, but they suggest that it may be possible in the future to do away with accumulators, and heat directly from the main. This the present writer has now been doing for over two months, and has so far every reason to be satisfied with the change.



Plan of wiring for Coolidge Tube on direct current mains, coil and mercury break outfit. The arrows at the top of diagram indicate beginning and end of heating circuit.

The method employed is shown in the accompanying diagram, which illustrates all the connections for a coil and mercury break outfit running on a 220 volt main.

Three wire system ; 440 volt dynamo – central neutral earthed wire – 220 volt circuit on each side.

As the existing Coolidge heating filament is built to stand a current of 5-6 amps. at a pressure of 10 volts only, it is necessary to insert in the first place a resistance which will pass a maximum of 6 amps. at 220 volts. This resistance is shown at A ; B is a variable resistance in series with A, designed to reduce the heating current to a minimum of 3·5 amps. These resistances are earthed at the power station, through the central neutral earthed wire. An ampère-meter and fuse are placed in circuit, as shown at E and F.

The above completes the arrangements for heating the tungsten filament. The high-tension circuit is dealt with as follows: the negative pole of the coil, C, is connected to the earthed side of the heating circuit at some point between E and F. Grounding occurs through the resistances B and A—which are, of course, non-obstructive to the high-tension current—and ultimately at the power station. The heating circuit and mains are thus free from high potential charge, while the efficiency of the coil as a tube-exciter is, if anything, increased.

To start the tube the heating circuit switch is thrown in, and a suitable ampèrage arrived at for the particular work in hand. When a matter of 3-4 milliamps. is being passed through the tube at an equivalent gap of 7-9 ins., as for deep therapy, no appreciable fall in the heating circuit occurs when the main switch of the coil is thrown in ; but if a very heavy ampèrage is desired in the primary for a brief period, as in rapid radiography, the current in the filament is apt to lessen somewhat at the moment when the primary circuit is made, and, of course, the tube hardens.

This inconvenience can be avoided, after experience is gained, by slightly overheating the filament previous to throwing in the main switch with all resistance in the primary circuit cut out.

I have already administered over 200 treatments under the above system, and have so far found no drawbacks. The steadiness of the current is at least as good as with accumulators at their best; one is freed from the worry of recharging, and from their numerous vagaries. The use of the Coolidge Tube becomes as simple as that of any other, and its great advantages cease to be in any way detracted from by complications or inconveniences. As to the grounding of the negative high tension pole, I have now had experience of two coils, a Watson and a Schall, and, so far, no trouble has developed. But if existing coils should show any tendency to break down some extra insulation between primary and secondary would get over the difficulty.

If it should prove possible in future so to modify the tungsten filament in the Coolidge Tube, and to increase the insulation of the heating circuit to such a point that a 200-250 volt. current of small ampèrage can be employed, it would then be practicable greatly to reduce and simplify the resistance which at present one has to use, and also to avoid wastage of power.

The heating system above described can be applied equally well when the direct current is used to drive a rotary converter, which again supplies alternating current for a Snook. Where the main supply is alternating, it is probably best to employ a small step-down transformer to heat the filament.

In conclusion, I wish again to express my indebtedness to Messrs. Shorten and Barnard ; also to my assistant, Sergt. J. E. Banks, R.A.M.C., for help in working out practical details.

ROENTGEN RAYS FROM SOURCES OTHER THAN THE FOCAL SPOT IN TUBES OF THE PURE ELECTRON DISCHARGE TYPE.

By W. D. Coolidge and C. N. Moore.

Research Laboratory, General Electric Company.

Reprinted from the "General Electric Review," April, 1917.

Early in the history of the hot cathode type of roentgen tube, and before any other roentgenograms had been made with it, the pinhole-camera-picture method was applied in a preliminary study of the source of the roentgen rays from the tube. This work showed that the entire surface of the target was active in producing roentgen rays. In spite of this fact, however, experiments showed that good roentgenographs of the various parts of the human body could be produced with the tube.

Since that time, various workers have felt that still better roentgenographic results might be obtained if all rays other than those coming from the focal spot could be eliminated.

It seemed desirable to investigate the subject pretty thoroughly to learn, first, how the effect of roentgen rays other than those coming from the focal spot could best be minimized, and, second, whether the elimination of this effect would result in roentgenographic images of greater diagnostic value. The investigation also seemed worth while for the light which it would throw on the *modus operandi* of the hot cathode type of roentgen tube and for the use to which such information could be put in the development of new forms of this tube. The investigation consisted mainly in a pinhole-camera-picture study of various forms of the tube.

The following pinhole-camera roentgenograms were all made under the same general conditions: The same diaphragm, with a hole 0·020 inches in diameter, was used throughout; the distance from the length axis of the tube to the pinhole was always the same, 15 in., and the distance from the pinhole to the photographic plate was 5 in.; and in all length views of the target the tube was so placed that the neck of the target was directly opposite the pinhole (see Fig. 1). The plate was in a closed box made of lead $\frac{1}{8}$ in. thick. Unless otherwise noted, the same voltage, that corresponding to a 7 in. spark gap between points, was used throughout, and the same current, 4 milliamperes, and the same time, 10 minutes. Time development for 4 minutes at the same definite temperature and with fresh developer was used on all of the plates. To still further guard against the possibility of unequal development, as well as to make comparison easier, a pinhole-camera roentgenogram of the standard tube has in many cases been put on the same plate with the particular type which was being investigated. No protection of any kind, not even the usual lead glass bowl, was used around the tube and no cone or diaphragm.

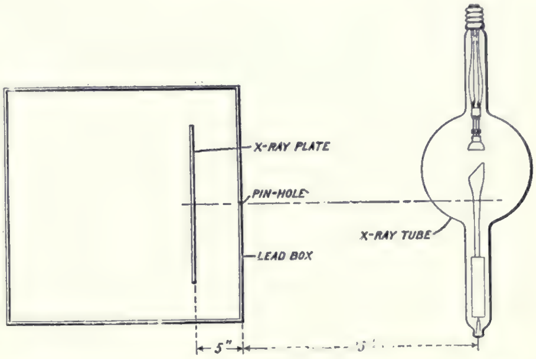


Fig. 1.—Arrangement of Apparatus for making Pinhole-Camera Roentgenograms shown in this Article.

Pinhole-Camera Roentgenograms made with the Standard Hot-Cathode Tube.

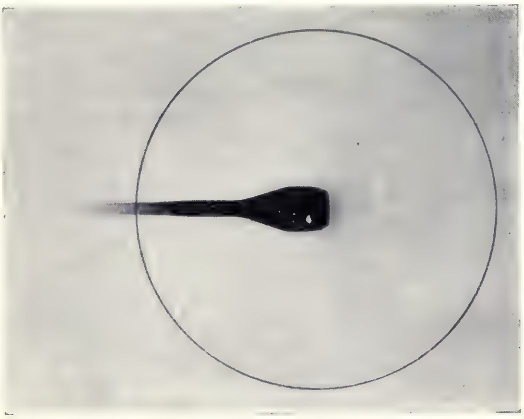


Fig. 2.—Roentgenogram made with Standard Medium-focus Tube.

Fig. 2 was made with a standard medium focus tube, operating with the voltage corresponding to a 7 in. spark gap between points and with 4 milliamperes of current for 40 minutes. The image of the focal spot is greatly overexposed, so that the roentgenogram gives a very exaggerated impression of the amount of radiation coming from the remainder of the target. The overexposure was intentional, the idea being to show the relative intensities of the radiation coming from those portions of the target other than the focal spot. The roentgenogram shows that the entire target, including the molybdenum stem and the adjacent end of the iron support tube, gives off roentgen rays and must, therefore, be bombarded by cathode rays from some source or other. The circle described about the middle of the focal spot as a centre indicates the location of the glass bulb. As will be pointed out in connection with some of the later plates, the production of roentgen rays from the entire surface of the target must be accounted for by the reflection* of cathode rays from the focal spot. These reflected rays, consisting as they do of negatively charged particles, electrons, cannot go to the cathode, as it is negatively charged. Nor can they go to the glass bulb, as it is charged to the potential of the cathode. They come away from the focal spot, as will be shown later, with almost as high a velocity as that with which they approached it ; but, by the repulsion of the charges on the cathode and on the glass, they are forced to go back and strike the target again, and many of them are doubtless again reflected and again forced to return to the target. Roentgen rays must be produced with each collision with the target. It is clear from Fig. 2 that relatively few electrons are able to get into the anode arm, because of the repulsion of the negative charge on the bulb back of the anode and on the walls of the anode arm. The intensity of the rays coming from the stem will be seen to fall off very rapidly at the point where the circle crosses the stem.

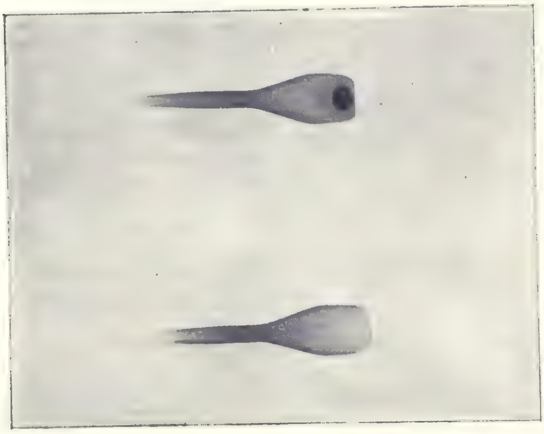


Fig. 3.—Roentgenograms of Front and Back of Target Note that, except for Working Face, Intensity is practically the same Front and Back.

Those surfaces of the cathode structure which face the anode are also seen to give off roentgen rays. The origin of these is entirely different in its nature. They are secondary roentgen rays produced by the primary roentgen rays coming from the target.

Fig. 3 shows the front and back of a target. Except for the working face, the intensity is seen to be essentially the same both front and back. The intensity of radiation appears greater at the peripheral than it does in the central portion of the picture, and, in general, the greater the angle of inclination of the surface with reference to the plane of the photographic plate, the greater is the apparent intensity of radiation. This is simply due to the fact that the roentgen rays are emitted with equal intensity in all directions from each and every point in the surface.

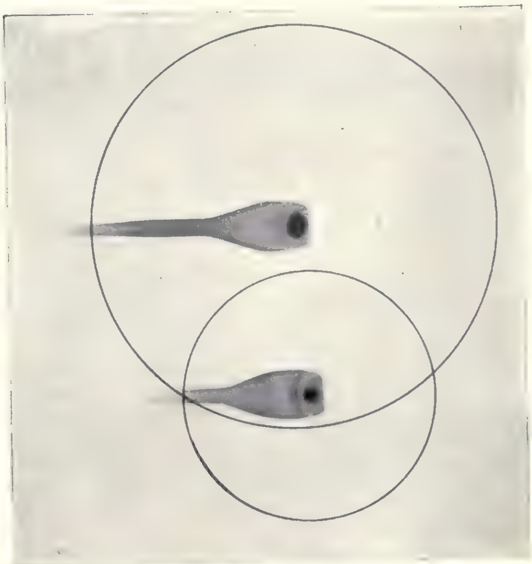


Fig. 4.—Roentgenograms made with 7 in. and 3¾ in. Tubes.

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* The term reflection has been used throughout this paper to include both true reflection and secondary emission.

In Fig. 4 the roentgenogram at the top was made with a 7 in. tube and that at the bottom with a 3¾ in. tube. The circle described about the middle of each focal spot as a centre gives the location of the glass bulb in each case. The figure brings out strikingly the effect of the negative charge on the glass in determining the extent of the target to be bombarded by the reflected cathode rays. The total production of roentgen rays outside of the focal spot s doubtless the same in both cases. (No attempt has been made to confirm this quantitatively.) But there is very little coming from that portion of the stem which is within the anode arm, and therefore there is, of necessity, a greater intensity of radiation from the body of the target in the small tube than there is in the large one.

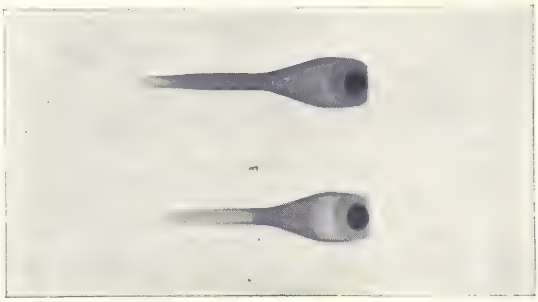

Fig. —5. Roentgenograms showing the effect of voltage. Upper, 10 in. Spark Gap; Lower, 2in. Spark Gap.

Fig. 5 shows the effect of voltage. Both roentgenograms were made with the same tube, the lower one with a 2 in. spark gap (between points) and the upper one with a 10 in. spark gap. The exposures were so chosen, by means of a preliminary set of experiments, that the photographic effect of the rays from the focal spot should be the same in both cases. This meant an exposure of 30,000 milliampere seconds for the 2 in. spark gap and 3,500 for the 10 in. spark gap. The body of the target, which is of tungsten, shows a somewhat different distribution of radiation in the two cases, the working face and the entire forward portion showing less radiation at the 2 in. spark gap, and the rear portion more. The molybdenum stem radiates very feebly at the 2 in. spark gap, so that there is no trouble in seeing where it is attached to the tungsten head of the target. The explanation for the feebler radiation of molybdenum is, as will be seen later, to be found in its lower atomic weight. At the 10 in. spark gap the molybdenum stem is seen to radiate even more strongly than the tungsten. This is due to the fact that, at this higher voltage, there is added to the general radiation of the molybdenum the characteristic radiation of that element.

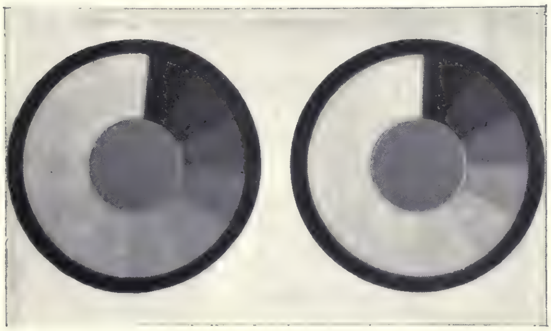

Fig. 6.—Roentgenograms of a Benoist Penetrometer. Right, Rays from Front of Target; Left, Rays from Back of Target. Exposure for Front of Target 1/10 that for Back of Target. 2in. Spark Gap.

To give an idea of the relative intensity and penetrating power of the radiations from the focal spot and from the balance of the target, two roentgenograms of a Benoist penetrometer were made, one with the rays from the front and the other with the rays from the back of the target. These are shown in Fig. 6.

Both were made with a 2 in. spark gap. The one to the right was made by rays coming from the front of the target and was given, as measured in milliampere seconds, 1/10 the exposure of the other. The central circular areas show very nearly the same photographic action, indicating that the total radiation from the back of the target is, photographically measured, about 1/10 of that from the front. This means that in the ordinary roentgenogram, made from the front of the target, there will be, photographically measured, about 1/9 as much radiation from the body and stem of the target as there is from the focal spot. This fraction would, in ordinary work, be reduced a little by the use of a diaphragm and cone. The penetration is seen to be about 4½ Benoist from the back and 5 Benoist from the front.

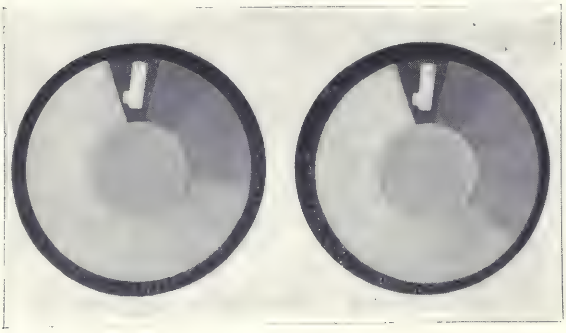

Fig. 7. Roentgenograms from Front and Back of Target as in Fig. 6, but with 10 in. Spark Gap. Exposure 1 to 9.

With a 10 in. spark gap, as shown by Fig. 7, the conditions are seen to be much the same. As before, the right-hand roentgenogram was made from the front, and the other from the back of the target. The exposure from the front, as measured in milliampere seconds, was 1/9 of that from the back and was apparently a little too much. The factor of 1/10 used in the preceding figure would have been better. The penetration from the front was 9 Benoist, and from the back 8 Benoist.

Photographically measured then, there appears to be from the front of the target, over this wide range of voltage, approximately 1/9 as much radiation coming from the balance of the surface as there is from the focal spot, and of but slightly less penetrating power.

METHODS FOR MINIMIZING THE EFFECT.

Hooded Target.

One of the different methods which has suggested itself for reducing the effect of the radiation from outside of the focal spot is the use of a metal hood attached to the working end of the target. This is illustrated in Fig. 8 and has been described in an earlier paper.* The cathode rays enter through a hole in the end of the hood and the roentgen rays emerge through a hole in the side. Fig. 9 shows the roentgenogram from such a hooded target, and above it, for comparison, that of the target in a standard tube. Fig. 10 shows the same thing except that the targets are turned

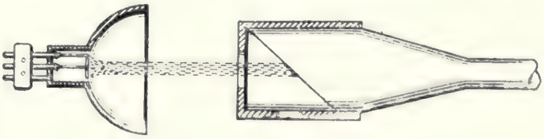

Fig. 8.—Metal Hood on Working End of Target.

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*W. D. Coolidge, Am. Journal of Roentgenology, Vol. II, p. 882 (1915).

sidewise. The position of the focal spot has, in the case of the hooded target, been indicated by those roentgen rays from the focal spot which penetrated the molybdenum hood, which in this case was only $\frac{1}{32}$ in. thick. A comparison of the two roentgenograms shows that the amount of radiation from the body and stem of the target is greatly reduced by the use of the hood. (Quantitative measurements with the ionization chamber show that with the design of hood used in this experiment, the reduction is to about 1/6 to what it would be without the hood.)

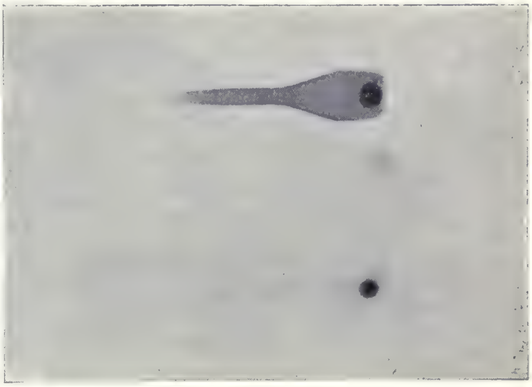

Fig. 9.—Lower, Roentgenogram of Hooded Target; Upper, Roentgenogram of Target of Standard Tube.

The roentgenograms of the hooded target are, of themselves, sufficient to prove that at least all of that radiation from outside the focal spot which is eliminated by the use of a hood must be due to cathode rays reflected from the focal spot. Without such proof, one might think that much of this might be due to failure on the part of the cathode focusing device to bring to the focal spot all of the primary bundle of cathode rays. An inspection of the hooded target roentgenogram in Fig. 10 shows the true explanation. Through the hole in the side of the hood can be seen a small portion of the inner surface of the hood, and this area shows a very vigorous roentgen ray production. The hood is in good metallic contact with the target, and is therefore of necessity at the same potential as the latter. There is then no force to deflect any of the rapidly moving primary cathode ray stream out of its course and to bring it to the inner surface of the hood. The only possible explanation remaining then, is that the vigorous bombardment of the inner surface of the hood, which manifests itself not only through roentgen ray production but also by a very rapid heating of the hood (upon starting to excite the tube with a cold target the hood comes to incandescence before the body of the target does), is due to cathode rays reflected from the focal spot. The reflection is not prevented by the hood, but the roentgen rays resulting from the reflected cathode rays are produced on the inner surface of the hood instead of being produced on the outer surface of the target. The fact that the roentgenogram shows more intensity on the lower side of the target is

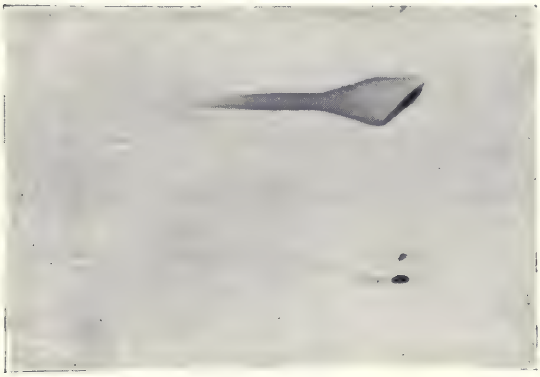

Fig. 10.—Same as Fig. 9, except that Targets are turned Sidewise.

easily accounted for by assuming that a few of the reflected rays come out through the hole in the side of the hood and then bombard the body and stem of the target on that same side.

Fig. 11.—Upper, Roengtenogram of Hooded Target; Lower, Roentgenogram of Hooded Target with Tungsten Foil

Fig. 11 shows two hooded targets differing only in this respect, that in the lower one a piece of thin tungsten foil (0·0008 in. thick) has been bound over the hole in the side of the hood. This would necessarily prevent any of the reflected cathode rays from escaping at this point. An inspection of the roentgenogram shows that the use of the foil has prevented the difference in intensity on the two sides of the target which is noticeable in the case of the hooded target without the foil. It seems most probable, especially in the light of Fig. 14, which will be described later, that the small amount of radiation remaining on the surface and stem in the case of the hooded target with the foil is due to reflected cathode rays coming from the focal spot and emerging through the hole in the end of the hood, through which the primary cathode rays enter. The number of electrons escaping in this way would naturally be relatively small, owing to the fact that the angle subtended by the hole is small, and to the further fact that these electrons have to move out against the electrostatic repulsion of the cathode.

Cathode Placed Very Close to Anode.

Another method which has presented itself for reducing the intensity of the roentgen radiation from the body and stem of the target consists in bringing the cathode so close to the anode that the reflected cathode rays are driven almost straight back to the focal spot by the electrostatic repulsion of the cathode.

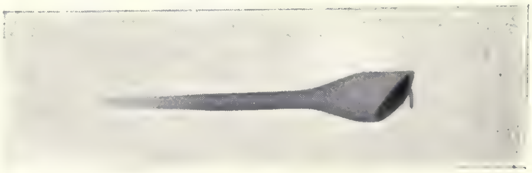

Fig. 12.—Roentgenogram of Target of Tube in which Cathode is Placed Very Close to Anode.

In Fig. 12 the front end of the molybdenum focusing tube of the cathode was only 2·5 mm. from the anode at its nearest point. (This front end of the focusing tube is clearly visible in the figure, due to the secondary roentgen rays emitted by it.) The roentgenogram shows that the reflected electrons which started out in this direction were forced, by electrostatic repulsion, to again bombard the target on its face, close to the focal spot. Those leaving in other directions, where the distance between the end of the cathode and the inclined face of the anode was greater, were able to get much further away from the focal spot.

Fig. 13 is the diagram of a tube representing a more radical experiment. In this tube the working face of the target was at right angles to the axis of the tube and the distance between the end of the focusing device and the face of the anode was only 2·3 mm. (In this tube, the filament spiral, to prevent its being pulled out under the strong electrostatic attraction, was set much further back than usual in the focusing device.)

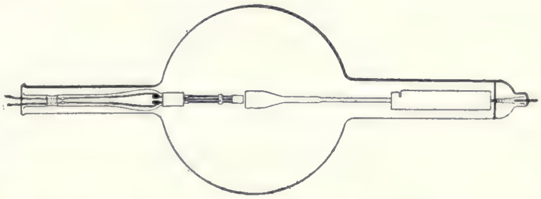

Fig. 13.—Tube in which Working Face of Target is at Right Angles to Axis of Tube. Distance between focusing device and face of anode, 2·3 millimetres.

At the bottom of Fig. 14 is seen the roentgenogram of this tube, the rays being taken from the face of the target in a direction making a very small angle with the face. The small round spot in the centre of the target face is the focal spot, seen through the molybdenum focusing tube. The concentric circular ring around this is due to the reflected cathode rays which, instead of being allowed to bombard the target all over its surface, have been forced to return to points close to the focal spot. Comparison of this roentgenogram with that of the standard tube above it shows how very effective this method has been.

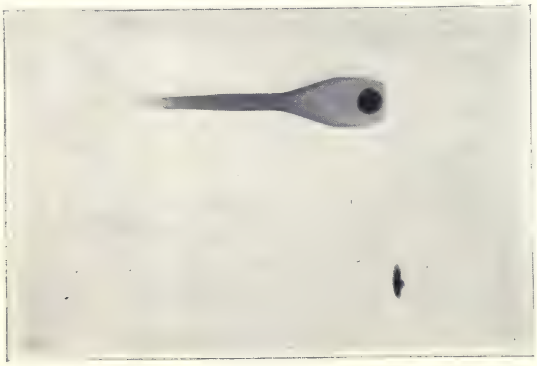

Fig. 14.—Lower, Roentgenogram of Target of Tube shown in Fig. 13; Upper, Roentgenogram of Target of Standard Tube.

Influence of the Atomic Number of the Metal on which the Reflected Cathode Rays fall.

Fig. 15 is the roentgenogram of a target consisting of a tungsten button, 19 mm. in diameter, set in a block of copper 32 mm. in diameter, the latter being supported by a stem of molybdenum screwed into it. The line between the tungsten and the copper is quite marked in the roentgenogram, and the roentgen ray production is clearly less from the copper than it is from the tungsten. This is in accordance with data published by Kaye on the efficiency of different metals in producing general roentgen radiation (not including characteristic) under a given cathode ray bombardment. His measurements were made with 25,000 volts on the tube.

Fig. 15.—Roentgenogram of Target, Consisting of Tungsten Button set in Block of Copper.

(To be continued.)

REPORT OF SOCIETY.

THE RADIUM INSTITUTE, LONDON.

* *A Report of the Work carried out from January 1st, 1915, to December 31st, 1916.*

By A. E. Hayward Pinch, F.R.C.S.,
Medical Superintendent.

(Published with the Authority of the Committee.)

(*Continued from* p. 154.)

Carcinoma of the Breast.

Radium should never be used as a substitute for operative interference in the treatment of early cases of mammary cancer, and should be resorted to only when the disease is inoperable, or the patient has refused to submit to operation.

In slow growing cases of the atrophic type, it is often of very considerable use in checking the progress of the disease, arresting or even healing any existing ulceration, diminishing induration and lymphatic engorgement, and ameliorating the pain. It will quite frequently cause the disappearance of small subcutaneous nodules, and reduce the size of infected glands.

To produce these results prolonged exposures with powerful applicators screened with 2 mm. of lead and containing 250, 300 or more milligrammes are necessary, and the exposures will probably have to be repeated at intervals of two or three months. Isolated recurrent nodules, inoperable by reason of their attachment to bone or cartilage, are best treated by the insertion of a small powerful emanation tube screened with 1 mm. of silver or 0.3 mm. of platinum into their substance for from eighteen to twenty-four hours. This procedure is quite frequently followed by complete disappearance of the nodules.

In cases where pleurisy or ascites resulting from carcinomatous infection of the pleura or peritoneum exists, striking results often follow upon the application of powerful screened apparatus over the affected area. Paracentesis should be performed shortly before the exposures are given, and further accumulations of fluid are then generally either much decreased or effectually prevented.

Rapidly growing carcinomata of the medullary type are but little affected by radium, and not much benefit other than possible relief from pain is likely to follow the employment of even very large dosage.

Rodent Ulcer.

This is of all forms of malignant disease the one which is most amenable to the action of radium. Lesions which have not been subjected to any previous treatment with X rays, CO_2 snow, ionization, etc., which do not affect mucous membrane, bone or cartilage, and do not exceed 3 cm. in diameter, can almost invariably be cured by one treatment. A full-strength applicator is used unscreened, and an exposure of between one and a half and three hours' duration given, the length of exposure being determined by the amount of induration and infiltration present.

The reaction which follows upon this procedure is usually severe, but the resultant scar is smooth, supple and inconspicuous, and the tendency to recurrence extremely slight.

When the extent, position, or character of the ulcer preclude the possibility of strong unscreened exposures, the best results will probably be attained by prolonged exposures with heavily screened apparatus.

The much thickened and indurated edges so often met with in cases of very long standing respond very satisfactorily to the action of powerful emanation tubes screened with 0.3 mm. of platinum and buried in the thickened border for from twelve to eighteen hours.

Sarcomata.

These growths usually do well, if treated before dissemination into any of the internal viscera has taken place. It is very important, however, that the treatment should be vigorous, and whenever possible it should be carried out both by the burying of emanation tubes within the substance of the growth, and by the external application of powerful screened apparatus, a total exposure of about thirty hours' duration being given and repeated after five or six weeks.

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* Abridged form, reprinted with permission from the Radium Institute.

The best results are seen in lympho-sarcomata, and the response of this class of tumour to radium therapy is very remarkable, the growths commencing to shrink within a few days of the termination of the treatment, and rapidly disappearing. Some systemic disturbance is generally noticed, the temperature rising to 101°—102°, with great languor and occasional nausea or even vomiting. These symptoms, however, prove quite transient, and rarely persist for more than four or five days.

Sarcomata of the tonsil and post-nasal space give almost equally good results, as do also periosteal sarcomata of the long bones, if treated at an early stage.

Lymphadenoma.

Cases of this disease of not very long standing, and in which the secondary anæmia is not severe, and the spleen and mesenteric glands are unaffected, generally derive great benefit from radium treatment, the enlarged glands disappearing, and the disease being arrested.

The patients must, however, be kept under close supervision and the treatment repeated if any signs of recrudescence appear.

Prolonged exposures with powerful and heavily screened apparatus are employed, and the series repeated at intervals of three, six or twelve months as may be necessary.

Mediastinal Tumours.

These growths appear to be particularly susceptible to the action of radium, and in almost every case that has come under observation considerable benefit has resulted. The rate of growth has been checked or arrested, and often an actual decrease in the size of the tumour has been clearly established by X-ray screening.

If the condition be accompanied by an accumulation of fluid in the pleura, and paracentesis be performed before the treatment is commenced, radium seems to exert a very remarkable action in lessening the tendency to the production of further effusion.

In these cases the use of a very large quantity of radium (400 to 500 mgr.) is indicated. The applicators should be screened with 2 mm. of lead, and disposed in such fashion over the chest wall as to procure the maximum "cross fire" irradiation.

Treatment must be very persistent, a total exposure of not less than thirty hours' duration should be given, and repeated at intervals of six weeks or two months.

This heavy dosage is almost invariably followed in two or three days' time by a feeling of great fatigue and exhaustion with a slight rise of temperature; but this disturbance is quite transient, and disappears completely in about a week.

Fibroid Disease of the Uterus.

Satisfactory results are often observed to follow upon the radium treatment of this disease, more especially when menorrhagia and metrorrhagia are the most prominent and troublesome symptoms.

When all ordinary methods of treatment have failed, and the patient declines to submit to operation, radium therapy is well worthy of trial, as it will almost certainly lessen or abolish the excessive loss of blood, and will, in addition, sometimes produce considerable diminution in the size of the uterus.

Treatment is best carried out by the introduction of a tube containing 100 mgr. screened with 2 mm. of lead into the body of the uterus—or if this be impracticable, into the posterior fornix—supplemented by a plate of from 80 to 100 mgr. screened in similar fashion, and applied on the abdominal wall above the fundus uteri.

The total exposure should be not less than thirty hours' duration, and the series should be repeated after two or three months.

The period immediately succeeding the radium application is often more profuse than usual; then the metrorrhagia is checked, and this is followed by a progressive decrease of the menorrhagia, until the flow becomes normal; or, as is sometimes seen in very susceptible subjects, amenorrhœa occurs, and persists for four, six or more months.

Papilloma of Bladder.

Encouraging results have been obtained in the treatment of the few cases of this disease which have come under notice. The hæmaturia has been lessened or completely checked, and shrinking of the papillomatous growths has taken place. Pain and frequency of micturition have been much relieved, and the patient's general health greatly improved.

Lupus Vulgaris.

This condition usually responds better to treatment with Finsen light than with radium; but when the former method of treatment fails to effect a cure, radium may be used with a fair prospect of success.

Treatment must be vigorous, however, and an exposure of one to one and a half hours' duration with an unscreened applicator given. This produces a very definite reaction with formation of a crust, which when it separates leaves a smooth and supple scar.

Nævi.—Flat Superficial Nævi, Capillary Nævi, "Port Wine Stain."

These lesions, when small, superficial, and easily blanched by slight pressure, may be treated by one exposure with an unscreened apparatus of from thirty to sixty minutes' duration. If extensive, and tending to infiltrate the deeper tissues, treatment will be long and tedious, and much care and patience will be necessary to produce a satisfactory result. It is best to use applicators screened with $\frac{1}{100}$ mm. of aluminium, and to give at first exposures of from fifteen to twenty minutes' duration, repeating the treatment every six weeks, and gradually increasing the time of exposure till a definite lightening of the colour is obtained. So soon as the lesion has assumed a salmon-pink tint the screening should be altered to $\frac{1}{10}$ or $\frac{2}{10}$ mm. of lead, and the length of exposure increased to one and a half or two hours.

These exposures must be given at longer intervals of three or four months. Careful watch must be kept for the occurrence of telangiectases, and should any appear, they must be promptly treated with a fine-pointed electric cautery.

Cavernous Nævi.

These should be treated at the earliest possible moment, as their response to radium irradiation within the first six months of infancy is much more rapid and complete than in later life.

Applicators screened with $\frac{1}{10}$ mm. of lead are employed and so disposed over the tumour as to procure a maximum "cross-fire" irradiation.

Exposures of from thirty to sixty minutes' duration are given on each of three successive days, and the series repeated at intervals of six weeks. Little or no surface irritation follows this method of treatment, and the nævus shrinks gradually and steadily, till level with the surrounding skin.

Warts and Papillomata.

Warts and papillomata may be satisfactorily removed by exposures of from thirty minutes' to two hours' duration with unscreened applicators.

The time of exposure must be proportioned to the size and thickness of the lesion. If this be accurately adjusted the surface reaction is slight, and little or no scarring results.

Keloid.

In young subjects and when the growth is of recent origin, the radium treatment of keloidal scars is most successful. Powerful applicators screened with 1 mm. of silver should be employed, and exposures of from twelve to twenty-four hours' duration—six hours on each of two, three, or four successive days—should be given. The series should be repeated at intervals of six weeks.

By this method a gradual absorption of the keloidal tissues without any surface irritation is obtained.

In tender and painful keloids the anæsthetic effect of radium is generally very pronounced, and appears quite early during the treatment.

Old and very dense keloids sometimes prove refractory to the routine method of treatment, and in such instances the screening should be altered to $\frac{1}{10}$ mm. of lead, and exposures of three or four hours' duration given.

Lupus Erythematosus.

This very intractable and puzzling condition, which so often defies all the usual methods of treatment, frequently responds most favourably to radium.

Applicators sufficiently large to reach well beyond the borders of the lesion should be employed, either unscreened or screened with $\frac{1}{100}$ mm. of aluminium. Exposures of between thirty and sixty minutes' duration should be given, and repeated at intervals of four weeks.

Xerodermia Pigmentosum.

Two cases of this malady have recently been under treatment at the Radium Institute, and in both instances removal of the ulcerated warty growths from the affected areas was satisfactorily accomplished.

Pruritus

Radium is often of the greatest use in the treatment of this condition, especially if it be of long standing and associated with leukoplakia or hyperkeratosis.

When no actual lesion exists, and the trouble is purely nervous in character, the results are not so satisfactory, and often but little benefit results from the application.

No definite rules can be laid down as to treatment, as the local conditions vary so greatly, but if much leukoplakia or hyperkeratosis be present, applicators screened with 1 mm. of silver and used for periods of six, eight or twelve hours appear to be most effective.

If, on the other hand, but little alteration in the character of the skin or mucous membrane be apparent, exposures of from ten to fifteen minutes' duration with applicators screened with $\frac{1}{100}$ of aluminium are most likely to prove of benefit.

Chronic Eczema.

Isolated patches of chronic eczema without much subjacent induration are frequently cured by radium when other methods of treatment have proved ineffective.

Short exposures of from three to fifteen minutes' duration should be given, and repeated at intervals of two to three weeks until the lesions have disappeared.

The tendency to recurrence in these cases is but slight.

Exophthalmic Goitre.

When the routine methods of treatment have failed to produce any benefit in this condition, radium therapy may be resorted to justifiably, as it will sometimes prove of very great value.

Arthritis Deformans.

Increasing experience in the treatment of this disease serves to confirm the opinion expressed in previous reports that the daily administration of 250 cc. of radium emanation solution of a strength of not less than 1 millicurie per litre will often produce a very remarkable improvement in the condition of patients suffering from this intractable and distressing malady. Persons vary greatly in their degree of response to the treatment, but most good is to be anticipated when the patient is under forty years of age, the disease of but short duration and infective in origin, and the changes periarticular in type and multiarticular in distribution.

The monarticular type with a definite traumatic history is but rarely benefited, and little or no improvement can be expected when cartilaginous or osseous changes are predominant, as radium emanation solution is powerless to bring about the absorption of osteophytic growths or the loosening of bony ankylosis. In susceptible subjects radium emanation solution has a most beneficial effect upon the general health; the muscular tone improves, the hæmoglobin index rises, pain disappears, and sleep becomes sound and undisturbed.

Digestive disturbances of slight degree are also often abolished, and the action of the bowels becomes freer and more regular. Diuresis is almost invariably noted.

Cases with a definite gouty history sometimes experience an acute exacerbation of all their symptoms within the first week or ten days of their treatment, but this disturbance is quite transient, and is usually followed by a distinct change for the better.

I desire to express my very great indebtedness for much valuable assistance in the compilation of this report to my colleague, Dr. J. E. A. Lynham, who, during the past two years, has been solely responsible for the conduct of the night clinic, and for the treatment of all the patients attending it.

The cases and opinions are the result of our joint observations.

Report of the Chemico-Physical Laboratory.

By W. L. S. Alton, F.I.C., *Director.*

On account of the depletion of the laboratory staff by military exigencies, very little new work has been attempted; the preparation of radium emanation applicators and radium emanation solution having entirely occupied the time of the members remaining.

Emanation Applicators.

The output of these applicators continues to be maintained, and a table is given for the numbers made in 1915 and 1916.

	1915.	1916.
No. of emanation tubes and applicators prepared	507	593
Initial activity in terms of Radium Bromide ...	39·8 grms.	42·42 grms.

The average strength of each applicator is thus equal to about 75 mgrs. of radium bromide, and the strongest tube made during the period was one equal in activity to 263 mgrs.

These tubes and applicators have been used by medical men and by hospitals for patients unable to bear the strain of travelling to and from the Institute, and many of them have been supplied gratuitously for the treatment of necessitous patients. As the methods of manipulation improve, the tendency is to decrease the size of the tubes made for insertion into growths. It has been found possible to charge with emanation, capillary tubes which fit into platinum needles of a total length of 14 mm., diameter 1·7 mm., and thickness of wall 0·3 mm.

The glass capillary tube that fits such a screen has a capacity of about 3·5 cubic millimetres, and can be made to contain emanation equal in activity to 50 mgrs. of radium bromide.

It is convenient to make this tube much longer than the screen it is intended for, shortening the tube by cooling one end in liquid air, and when the internal pressure is lowered, reducing the length of the tube by means of a mouth blow-pipe.

Radio-Active Water.

	1915.	1916.
No. of bottles of radium emanation solution distributed	17,492	10,836
Total output in litres	4,393	3,030

The initial strength of the solution has been maintained at between 1·5 and 2·0 millicuries of emanation per litre, which far exceeds that of any of the radio-active waters derived from natural sources.

Radium Applicators and Measurements.

	1915.	1916.
No. of radium applicators prepared ...	12	6

These applicators were prepared for medical men, and for hospitals in various parts of the world, but as is obvious, this type of work has been much restricted by the war. In addition, most of the radium applicators in use in the Institute have been either repaired or remade during the period 1915-1916.

	1915.	1916.
No. of measurements of radio-activity ...	12	4

A physical laboratory has been installed and equipped in the new building, and is in use daily for the purpose of standardising the emanation apparatus constructed.

NOTES AND ABSTRACTS.

RADIO-DIAGNOSIS.

Radiological Study of Fracture of the Base of the Skull.—FELICE PERUSSIA (*Radiologia Medica*, Nov.-Dec., 1916).—It is difficult to get a clear picture of true fracture of the base of the skull. The fissures most often seen are really in the anterior, lateral, or posterior wall rather than in the true base. Here there are so many superimposed shadows that special technique is needed. By adjustment of diaphragm, focus, etc., endeavour should be made to procure a clear, enlarged image while other layers are left indistinct and vague. Various oblique views may be necessary, but the central ray should always be vertical to the screen. The author's methods are described at length ; he does not favour the view obtained from below and to the side of the extended jaw.

A classification is given of types of fracture of the base, which are commonly radiations from fractures of the vault which have spread down the shortest line and that of least resistance.

The radiological signs are those of (1) solution of continuity of bone ; (2) presence of liquid or gas which has penetrated into a normal cavity ; (3) late and indirect results of (1) and (2).

The first appears as a line of increased transparency, and, if visible in the longitudinal direction and prolonged on to a wall of the fossa, can be accurately investigated. Otherwise, all the above mentioned devices must be adopted and careful study made, and comparison with the normal picture. It may still be impossible to confirm the clinical signs of fracture. The second condition is shown by loss of clearness, due to hæmorrhage into an air space, or, rarely, by abnormal clearness due to penetration of gas into the cranial cavity.

N. B.

The Roentgenological Diagnosis of Cerebral Lesions. — C. W. PERKINS (*Medical Record*, Feb. 3rd, 1917).—In these conditions radiology is very helpful when used in combination with other methods of diagnosis ; it requires a perfect technique and a radiologist who is at the same time a clinician, a pathologist, and a well trained anatomist.

The work must be based on a thorough understanding of the normal appearances and variations.

Brain tumours often show destructive changes in the skull structure, especially in the sella turcica, while the increase of pressure produces dilatation of the venous channels. An examination of fifty normal cases leads the author to classify three normal types of sella turcica, the short circular, elongated oval, and large rounded.

A discussion of the various signs of cerebral affections follows. N. B.

Roentgenology as a Cause of Psychic Disturbance in Soldiers, and a Useful Means of Diagnosis in certain Malingerers.—F. P. SGOBBO (*Radiologia Medica*, Nov.-Dec., 1916, p. 313).—The author discusses some uses and abuses of X rays in military cases. Knowledge by the patient of his radiological condition may lead to psychic disturbance, and has apparently done so, for in France there is an order forbidding access by patients to their X-ray reports or plates. A man suspected of simulation may really be much disturbed by the thought of the continuous presence in his person of some foreign body. On the other hand the author has seen several ingenious efforts at evasion of military service by the help of an X-ray report. He instances one who swallowed two bullets and then came for a report, saying he had been wounded by a revolver some years before and was not fit to fight, and another who simulated an injured elbow and injected a semi-opaque fluid under the skin in order to produce an abnormal shadow ! N. B.

RADIOTHERAPY.

Filters in Skin Radiotherapy.—PIDDONE (*Radiologia Medica*, Nov.-Dec., 1916).—In accordance with the general principle that hard, filtered rays are to be employed for deep treatment, and soft, unfiltered rays for superficial tissues, the author used to adopt the latter method for skin cases. In several cases this was followed by radio-dermatitis, but his faith was still unshaken; then he was worried by the ultimate dermatitis after depilation for tinea and tried the smallest aluminium filters. There were brilliant results and no more dermatitis. The author does not agree with Béclère and Zimmern, who say that filters do not protect the skin; he adduces arguments and says that others are beginning to reach the same opinion, and to use filters to obtain definite depilation without the unsightly inflammation which is worse than the disease. N. B.

Present Status of Roentgenotherapy in Leucæmia.—H. K. Pancoast (*Amer. Journal of Roentgenology*, Jan., 1917, p. 611).—Successful results require care in the preliminary treatment of the active stage of the disease, persistence in treatment until every manifestation has disappeared, a careful watch over the patient afterwards, and a resumption of applications on the first appearances of a relapse. The first indications of which are changes in the differential count, or a slight rise in the leucocyte count, or both. Referring to previous communications by Stengel and himself, Pancoast still recommends that the roentgen applications be directed mainly and primarily against what he believes to be the primary focus of the disease—the bone marrow. In the subsequent treatment of the spleen, the writer follows to some extent the method of Béclère. After the patient has received one or possibly two series of bone applications, Pancoast radiates the spleen, only one small area of which being treated daily at first, until he is certain the patient can stand more. It is far safer, he thinks, to give an intensive dose through a small portion of spleen than to give a comparatively small dose over a large area of the entire spleen.

As regards the use of arsenic, Pancoast advocates its use in small doses in those cases in which the progress ceases, and also those in which there is a low red count, or the red corpuscles or hæmoglobin are diminishing.

Benzol has recently become a strong competitor of the roentgen ray in leucæmia, but on careful comparison, he believes that the latter is to be preferred and is safer. The writer is opposed to the routine use of both agents at the same time, and for much the same reasons as for the employment of large doses of arsenic in conjunction with the roentgen ray. R. W. A. S.

The Treatment of Nævi.—W. S. Newcomet (*American Journal of Roentgenology*, Jan., 1917, p. 605).—The writer describes the various methods in use at present as follows:—

Surgical.—This is a safe and rapid method, but should be limited to well-defined, tumour-like masses which easily lend themselves to ligation.

Caustics.—The most commonly used are nitric acid, chromic acid, trichloracetic acid, pastes of arsenic, pyrogallic acid, salicylic acid, stick caustic, zinc chloride, and others, but as they are apt to leave a permanent whitish scar, the result is objectionable in skins of high colour. Freezing with ethyl chloride, the application of CO_2 snow or liquid air is, as a rule, less painful and can be controlled to a degree quite unattainable with chemical caustics. In addition, the results are better, and the remaining scar is not so liable to display that bleached, white colour which often makes the scars of chemicals unsightly.

Electrical.—Under certain conditions, the results from galvanism may be good. The various forms of high frequency, desiccation, fulguration, and diathermy depend more or less upon the same principle of producing an electro-chemical change in the tissue which, in turn, produces a certain amount of tissue regeneration. The ultimate scar will closely resemble the normal tissues. These methods are more or less painful and an anæsthetic is usually required.

Ultra-Violet Light.—Marked success has been obtained in some of the milder and more widely disseminated forms, the heavier areas being subsequently treated by other methods.

Radiation.—The radiation usually employed is that from radium. The danger of subsequent telangiectases and keloids is pointed out, and it is stated that the reaction from radium closely resembles that following a roentgen radiation with a spark gap of about eight inches and a four millimetre filter. The difficulty in treating these marks with any form of radiation lies in the unevenness of their structure. The heavy areas so often surrounded by lighter areas require a different dosage, and if the whole area is treated *en masse* the result will not be uniform.

As to the selection of the method for the various cases, Newcomet says, that so far as true nævi are concerned, the best results are to be expected in the cavernous type; there the veins are covered with healthy skin. In these cases the electric needle, galvanism, or diathermy will destroy the enlarged veins without injuring the overlying skin. If, however, the skin is involved and the superficial layer discoloured, the application of radium will give the best results. The form that presents the greatest difficulties is the very superficial and widely disseminated variety, and for which radium, high frequency, and the ultra-violet light have been used. The pigmented nævus, unless too deep, will yield most satisfactory results under roentgen rays or radium. The fact that these are covered with hair does not seem to have any effect upon the result. Where the nævus is thick and leathery the cosmetic result is questionable.

Newcomet states that in a general way radiation offers the best means for the eradication of the more severe types, while the smaller ones may be treated by many other methods with perfect results. A warning is issued that the scar tissue produced by caustics and similar methods is extremely sensitive to radiation.

The following are the conclusions of the writer:—

1. There is no ideal method for the treatment of "birth marks."
2. While certain methods are better adapted to certain classes of these "marks," the results depend largely upon the experience of the operator.
3. Any form of radiation employed is attended with some risk.
4. Whatever method is used, the first application should not be exaggerated.
5. Consideration must always be given to the trophic influence, which differs in proportion to the size and depth of these vessels and is difficult to control.
6. The earlier in infancy some form of treatment is adopted, the better will be the result, as involution will often continue when once a retrograde process is started, until the whole "mark" disappears.

R. W. A. S.

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ARCHIVES OF
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THE RADIO-DIAGNOSIS OF PULMONARY TUBERCULOSIS AND OF ITS DIFFERENT FORMS.

By Walker Overend, M.A., M.D. (Oxon), Chief Assistant in the X-Ray Department, St. Bartholomew's Hospital, London; and Godfrey T. Hebert, M.B., B.Ch. (Oxon), Tuberculosis Officer for Hackney.

1. The diagnosis of pulmonary tuberculosis, especially in its earliest stages, is a problem of great importance, and sometimes of considerable difficulty, on account of the *indefinite results* obtained by percussion and auscultation—even in the hands of the most careful clinical experts—and the *absence of bacilli* in the sputum; also, from the fact that in borderland cases one or more of the cardinal symptoms, first described by Morton (1), namely, (*a*) *cough*, (*b*) *pyrexia*, and (*c*) *loss of weight*, may be wanting. In many of these ambiguous cases the radiogram becomes extremely valuable for the establishment of the diagnosis, and, if positive, of the locality, character, and extent of the disease.

2. At the present time a diagnosis is constantly demanded from radiologists at our hospitals and tuberculosis dispensaries, on the one hand, with regard to men who have already been invalided out of the army as tuberculous and

are now recalled to the tribunals ; on the other hand, for recruits who may be thin, weedy, and anæmic, often possessing a long flat chest and a family history of the disease. The examination is conducted with a view to the determination of fitness for active service and the classification of capabilities. A carefully considered judgment is often imperative, since prolonged bodily and mental strain may reactivate foci already in a state of quiescence and temporary arrest, or may render the system incapable of resisting the establishment and dissemination of a new infection. Moreover, every affected individual may easily become a source of danger to his comrades under the conditions which obtain during active service.

3. In a previous article (2) it is shown that pulmonary tuberculosis, in its earliest stages, assumes the form of minute peribronchial (or periacinous) foci which are only discernible by means of the radioscopic screen and the radiogram. It is also asserted that the types most liable to render the clinical diagnosis uncertain are :—

(*a*) A purely *glandular* type (*adenitis bronchialis tuberculosa*), affecting the hilar, bifurcation, and paratracheobronchial lymphatic glands, separately or collectively.

(*b*) A *simple* or *attenuated* form of peribronchial tuberculosis.

(*c*) The *peribronchial disseminated* type.

(*d*) The *central* or *hilar* type, in which the parenchyma of the lung becomes gradually infiltrated from the hilar region.

4. Naturally, many intermediate cases occur between the attenuated, benignant, peribronchial type, in which small restricted areas only are involved, and the disseminated, in which the upper lobe, at least, may be almost completely filled with foci. The small opacities vary in size from that of a millet seed to that of a pea, and they may often be better seen on the screen than on the plate. For this reason, in addition to the anterior radiogram, it is often expedient to take posterior *stereograms* in order to obtain a comprehensive view of the different layers of the lungs.

5. With regard to the *differential diagnosis* of these small rounded opacities, the only sources of confusion appear to be :—

(*a*) The small round shadows seen in the *diffuse dilatation of the bronchi* after measles and pertussis, where they are really optical sections of small bronchial tubes filled with secretion. A picture taken after complete evacuation of the tubes may clear up the matter ; moreover, the arrangement is different. Further help may be obtained from the clinical history, and from the absence of tubercle bacilli from the sputum, even after some duration of the disease.

(*b*) *Fibrinous bronchitis*, which is rare, and easily diagnosed by the expectoration of bronchial casts, may show similar opacities.

(*c*) Opacities due to *miliary carcinomatosis* (*carcinose miliaire secondaire*) scarcely concern young adults.

(*d*) The shadows cast by engorged pulmonary veins and lymphatics, such as occur in the course of *mitral stenosis*, differ in appearance and distribution. Moreover, the shadows are, in general, more discrete, and they decrease in size *pari passu* as the periphery is approached.

6. Considering these radio-foci as the essential objects of our search, a classification may be attempted (*a*) in accordance with the particular localities of the lung in which they may be found grouped more or less abundantly, or (*b*) according to the actual extent of the area involved at the time of examination, and the number of foci perceptible. Subdivisions in each system would arise, in order to specify and contrast the method of evolution of the disease : (*bronchopneumonic*, *pneumonic*, and *fibrotic*) also, progressive, stationary, and retrogressive in each of the three subdivisions. As regards the radio-foci themselves, in the less advanced stages they may be (*a*) discrete, (*b*) aggregated and small, or (*c*) confluent.

7. *According to locality* we may discriminate, in order of frequency, (*a*) *apical*, (*b*) *hilar*, (*c*) *interlobar*, (*d*) *basal and diaphragmatic*, (*e*) *lingular*, and (*f*) *juxta-vertebral.*

Of these, the *apical* includes the area of the clinical apex bounded by a horizontal line running along the lower border of the fourth rib, where it joins the spine. In the *interlobar*, the radio-foci are grouped along the great fissure, or may more particularly affect the small fissure of the right lung, between the upper and middle lobes. *Basal* foci on the right side are usually obscured by the liver, and the diaphragm is practically immobile. In the *lingular* form, the lung between the nipple and cardiac apex (lingula of the left), or the corresponding part of the right middle lobe, may be packed with foci. A *juxta-vertebral* deposition of foci leading to consolidation may occupy the lower lobe.

Of these varieties, the apical is the commonest ; the hilar, interlobar, and basal are frequent ; the lingular and juxta-vertebral are rare.

8. *Apical Phthisis.*—According to the distribution of the bronchi within the upper lobes, apical forms may be subdivided into (*a*) *paravertebral*, (*b*) *midclavicular*, and (*c*) *axillary.*

The *paravertebral* bronchus runs parallel to the vertebral column and terminates within the circle of the first rib, supplying the acini in its neighbourhood and most of the supraclavicular apex. An aggregation of foci is prone to occur about the level of the osseous extremity of the first rib—in fact, this situation is the commonest of all. The area is better seen in the posterior plate, since the foci lie nearer the back. The radio-foci connected with the *midclavicular* bronchi appear at the level of the first anterior interspace ; those of the *axillary* within the second (3). In both instances they are more numerous towards the periphery. (Rad. I.)

9. *Hilar Phthisis.*—Postmortem examination, particularly in children, demonstrates the fact that considerable enlargement of the right hilar opacity, as seen on the radiogram and due to caseation of its glands, is often unaccom-

panied by any involvement *per continuitatem* of the surrounding parenchyma of the lung. Dissemination appears to occur more readily along the lymphatics, against the direction of the lymph stream, producing, *saltatim* and centrifugally, small disconnected caseous patches, the localities of which may possibly be determined by the topography of minute adenoid nodules. This may explain the occurrence of small fibroid patches containing caseating nodules within the adjacent extra-hilar parenchyma. Such a process of centrifugal dispersion appears less likely to occur in the adult. Faint homogeneous shadows, due to the enlargement of hilar, bifurcation, and peribronchial glands (4), may occur in the adult without any obvious active disease within the lung itself. These opacities are probably due to tuberculous inflammation of the glands, and may induce a clinical syndrome suggestive of the presence of active pulmonary tuberculosis, such as slight wasting, occasional night sweats, some persistent pyrexia, and at times a slight cough. It has been said that whenever a tuberculous focus is accompanied by disease of the glands which drain its area (regional), the infection is new and primary, and that where this fails, or is trifling, it is due to reactivation of an old focus. In the lung this law scarcely applies, although the conception may, in a few cases, agree with the radiological appearances.

Many of the men discharged from the army show paratracheobronchial and bifurcation shadows of such a nature as to suggest activity, but there do not appear to be any active foci within the lung itself. The opacities seem to be due more certainly to the recrudescence of latent foci within the glands themselves. On the other hand, in addition, there may be present a rapidly progressive phthisis and the median supracardiac shadow may then be much broadened.

10. *Interlobar Phthisis.*—Some of the so-called hilar centrifugal forms are possibly in reality *interlobar.* An instance of this type, the case of J— S—, æt. 26, follows:—

Patient's brother had suffered from pulmonary tuberculosis for two years. He himself had had a troublesome cough, with little expectoration, for about a year, but four or five examinations had failed to show the presence of tubercle bacilli. A small hæmoptysis occurred six months after the onset of the cough, and five more at irregular intervals. His weight remained stationary for the first six months, but after the onset of the hæmoptysis he lost in all 6 lbs. No other symptoms were noted, but his evening temperature was sometimes slightly raised. On the left side, between the vertebral end of the spine of the scapula and the spinal column, a few doubtful crepitations were twice noticed, but generally nothing abnormal was detected, and in June, 1917, he was classed B1 by a Medical Board. In the radiogram (Rad. 2), taken in July, 1917, there was a rounded opacity where the right sixth rib joined the vertebral column; spreading outwards towards the axilla were a number of smaller opacities, and above them, more cloudy, less defined shadows. Along the lower bronchi caseating glands were visible at intervals, and in certain situations the bronchi appeared dilated. The apices and the rest of the pulmonary fields were free.

11. Bard (5) isolated a form of chronic phthisis which he termed *phthisis fibrocaseosa congestiva*, that appears to correspond with this interlobar type. The focus is situated between the vertebral border of the scapula and the fifth dorsal spine; in front, in the neighbourhood of the mamma. In these situations there is dulness to percussion, and generally increased vocal vibration, soft tubular breathing, and a few sub-crepitant râles. In addition, foci may be present at the base. The same side of the chest is almost immobile; there may be a loss of vocal vibration, dulness with increased resistance on percussion, occasionally pain in the side, and a dry cough. The affection is, therefore, liable to be diagnosed pleurisy with effusion.

12. The *evolution* remains more or less *unilateral*, and progresses more slowly than does that of ordinary fibrocaseous phthisis; cavity-formation is uncommon even in chronic cases, and the tendency to fibrocaseation, fibrocalcification, or complete fibrosis is marked. To the radioscope, the pulmonary fields may be cloudy and may illuminate badly on deep inspiration, a condition sometimes due to congestion of the lung (*spleno-pneumonie tuberculeuse. Grancher*). Such individuals are liable to attacks of pyrexia (evening temperature 101°), lasting for several weeks. Hæmoptysis is frequent, but not large in amount, and may be induced by variations of barometric pressure, or by overwork and exhaustion.

13. *Lingular Phthisis.*—We have met with several instances where, in addition to a sparse distribution of foci in the apical regions, the lingula has been packed with foci of similar size and density, and as large as a small pea. In such cases the physical signs are indefinite. The foci are situated between the cardiac apex and the left nipple. If the area implicated lies somewhat higher on this side, the type becomes *cardiac*, *i.e.*, in the area of the *incisura cardiaca*. They are isolated by anterior radiograms only. Speaking generally, in all cases where the symptoms or the signs render the individual merely suspect, radioscopy alone is quite inadequate to solve the problem. Three radiograms are required; the anterior, if possible, should be of the size 15 in. by 12 in., the posterior should be stereoscopic, but 12 in. by 10 in. or even 10 in. by 8 in. in this position may suffice. (Rad. 3.)

14. *Peribronchitis Tuberculosa Benigna.*—In accordance with the *extent* of the area involved and the *number* of foci, we may divide *peribronchitis tuberculosa* into two classes, (*a*) *benigna vel attenuata* and (*b*) *disseminata*.

The former, as the term implies, is a mild form of pulmonary tuberculosis, which evolves very slowly and exhibits intermediate periods of quiescence of varying duration. The foci, not abundant, exhibit from the first a tendency to caseation, complete calcification, or fibrosis, thus becoming finally encapsulated and innocuous. They are found especially along the paravertebral, midclavicular, and axillary sets of bronchi, often in the immediate neighbourhood of the sternal osseous extremity of the first rib ("*zone des surprises*"), or within the first and second *anterior* interspaces towards the periphery of the chest. Opacities may be noted also outside the hilar area, between it and the apices, in the region of the right superior interlobe near the hilum, and along the bronchi running towards the diaphragm. The lines running towards the apices and bases, from the hilum and the general reticulum itself, may become pronounced and remain in this condition for years. These paravertebral striæ and the thickened reticulum elsewhere are the expressions of a latent, temporarily arrested tuberculosis, and are of no importance whatever in the determination of activity in the process of evolution.

15. Physical examination may reveal many evidences of arrested and cicatricial pulmonary tuberculosis, such as the flattening of one or of both clinical apices, diminished supraclavicular areas of percussion dulness, deficient respiratory murmur, harsh breath sounds with prolongation of expiration at the apex, often the right, and telangiectases around the cervicodorsal spines C7, D1, D2, and D3, especially in children (6). With the radioscope and radiogram, there will be diminished translucency of one apex, generally the right, or of both, with some illumination on cough (indicating the presence of thickened pleura), increased hilar opacities, some emphysema, diminished traverse of one or of both halves of the diaphragm, and calcification of the first rib cartilage. All these are merely the radio-signs of an arrested phthisis, that is, of an antecedent mild peribronchial tuberculosis (*peribronchitis tuberculosa benigna*). (Rad. 4.)

16. The lesions of mild peribronchial tuberculosis are, therefore, inextensive ; they tend to heal readily, often becoming permanently latent, and may be discovered only accidentally at the autopsy in the form of apical cicatrices, caseocalcareous or fibroid nodules surrounded often by emphysematous vesicles. The commonest situation on the radiogram for vicarious—in this case probably expiratory—emphysema lies in the second and third posterior interspaces (*tuberculous interspaces par excellence*), and these are often wider on one or both sides than those immediately below. Also, patches of chronic or fibroid pneumonia may be found postmortem in various situations—especially in the subclavicular triangles—which contain old caseating or caseocalcareous foci, or a dilated bronchiole. Small indurated tubercles may also be found beneath the pleura and in the hilar, bifurcation, and paratracheobronchial glands. Bard (7) makes a sharp distinction between the cicatricial survivals of old arrested tubercle and the slow progressive advance of true fibrosis of the lung. Radiography, however, does not lend itself to the establishment of such a marked contrast, since there are many intermediate forms which connect the simple cicatricial opacities of mild peribronchial tuberculosis with those of marked disseminated or dense fibrosis. Subsequent phenomena are due to excessive unilateral development of fibrous tissue, facilitated probably, in many cases, by the supervention of rheumatic or specific infections.

17. During the process of arrest, the chest may assume one of two

extreme forms,* (*a*) that of a general diffuse emphysema, and (*b*) that of the long flat thorax (*thorax paralyticus or aplati*), where the ribs run more obliquely and the last may almost touch the iliac crests ; also, the clavicle drops, so that at least four ribs may appear above it on the radiogram taken in the usual manner. There is, generally, a loss of mobility on the part of the diaphragm in each variety. Circumscribed patches of marked opacity seen on the plate along the upper bronchial divisions and in the neighbourhood of the hilum indicate areas of pneumonic fibrosis. In most cases of diffuse emphysema the hilar opacities are increased in size, are more opaque than usual, and may enclose darker areas (due to caseating and calcareous glands); or the hilum may appear on the plate to have passed into a general state of *hilar* or *central fibrosis*, with radiating dark lines extending into the parenchyma of the lung. Without doubt these are fibrosed bronchi. It is necessary for the radiologist to recognise carefully the appearance of these cicatricial remains, which are really the fibroid stigmata of old arrested disease, in order to avoid the reproach to which most specialists are subject —to wit—" they are sure to find something, even if there is nothing." (Rad. 4.)

18. There are many gradations between the state of permanent quiescence and that of well-established activity. Conditions of *temporary* arrest are more likely to occur up to the fourth decade ; after this period the latency is more prone to become *permanent*. In the minimal forms of activity, either primary or secondary, there may be little or no cough, the pyrexia may be trivial, and the weight may be constant, although the individual may remain thin. In other instances there may be a deceptive condition of toxæmic obesity (*obesité tuberculeuse*). The only complaint may be of lassitude, particularly after slight bodily or mental exertion. These are difficult cases to decipher, and require a searching examination by all the other methods at our disposal, such as the temperature curves of rest and activity, the qualitative leucocyte count, tuberculin, and other laboratory tests.

19. In tuberculous disease of the bronchial glands there is often a rise of temperature in the late afternoon which may prove very rebellious to treatment. Moreover, to add to the difficulties, in many obscure cases of pulmonary phthisis the activity is more real than apparent, since the partially restrained toxæmia displays its effects on some other region of the body, *e.g.*, on the digestive, vascular, or nervous system, producing hyperacidity, chlorosis, attacks of palpitation, hyperplasia of the thyroid, certain forms of neuritis (trigeminal and scapular), neurasthenia, and general malaise. An X-ray examination may emphasise the necessity of rest, of open air treatment, and of the administration of therapeutic doses of tuberculin.

20. *Hœmoptysis.*—In the *earlier stages* of the disease, if the X-ray tube has

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* There are intermediate varieties which are described later.

been of the proper degree of hardness, the radiogram, taken several days after the attack, may show either

(*a*) A caseating gland surrounded by what appears to be a network of dilated vessels ;

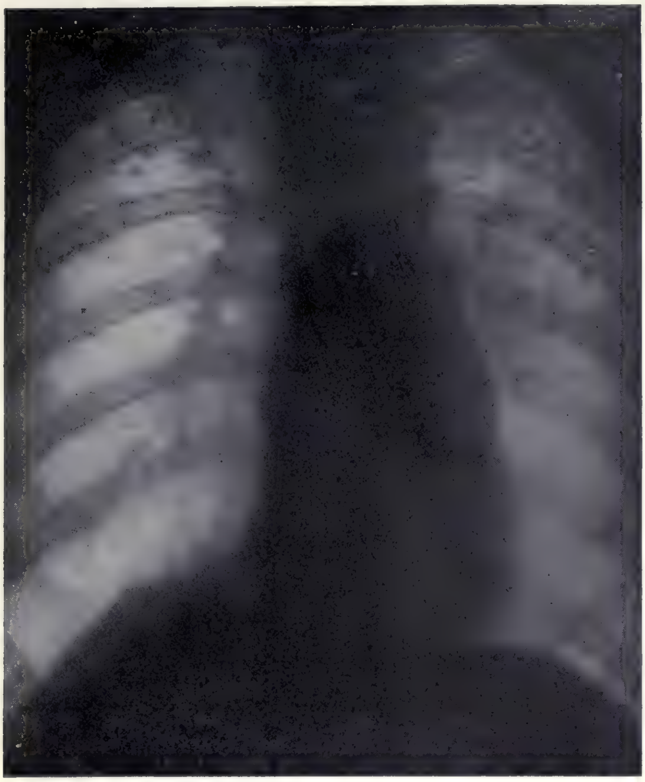
(*b*) A right interlobar pleurisy which casts a veil over the deeper layers ; or,

(*c*) An irregular patch of opacity, which is thin and apparently of the nature of a slight hæmorrhagic pneumonic consolidation. The commonest situation is at the osseous extremity of the first rib, in the second anterior intercostal space on the right side.

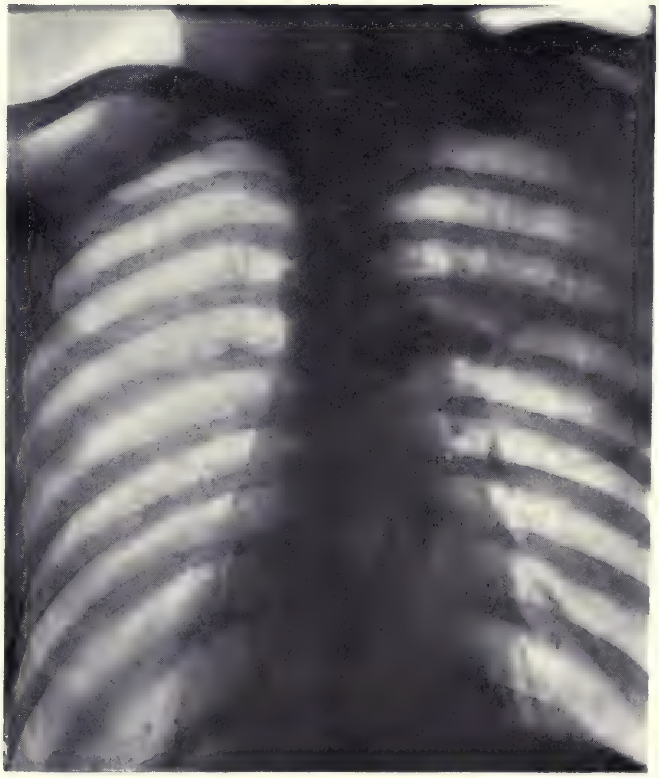
The first variety, in which the amount of blood may be very considerable, appears to be due to the rupture of a small vessel within an area of local congestion (8). There may be a small opacity, that is, a caseating focus, in the immediate neighbourhood. This hæmoptysis is associated with the mild peribronchial type of disease, is accompanied by no pyrexia, and by no tubercle bacilli in the sputum, and the patient otherwise appears in perfect health. The hæmoptysis may never recur.

21. The two other forms may occur in mild peribronchial phthisis, or in the next division, the disseminated type ; and they are accompanied by pyrexia lasting several days. When examined some weeks afterwards the interlobar effusion has vanished, and the separate foci again become visible. In other cases a pneumonic focus may be isolated. The amount of blood expectorated in the latter two forms is never large. The three varieties may therefore be termed (*a*) *vascular*, (*b*) *pleuro-pneumonic*, and (*c*) *pneumonic*.

22. *Peribronchitis Tuberculosa Disseminata.*—In the form of tuberculosis which has received this name, there is an extensive dispersal of small peribronchial tubercles, particularly affecting the upper lobes of one or both lungs. In the very early stages, at a time when diagnosis by the rays is easy, the only physical sign may be wavy or jerky breathing over certain areas (*respiration saccadée*), in a few cases indeterminate or post-tussive râles ; but the cough is troublesome, expectoration is present though perhaps scanty, and night sweats with evening pyrexia are noticed. Wasting may be considerable and progressive. In spite of the wide distribution, the process, however may assume a chronic character before the small radio-foci become aggregated or confluent. On the screen the pulmonary fields then appear markedly granular. In some, the process becomes almost entirely fibrotic, and the radio-foci appear as small discrete round black dots under the radioscope, although the individual in the meantime has become, to all appearances, quite vigorous and sound. The condition corresponds to that of some children who have overcome a massive infection to which they have been subjected (9). Occasionally the whole of the upper field in one or both lungs is filled with discrete maculæ which are smaller than usual, and in which arrest has

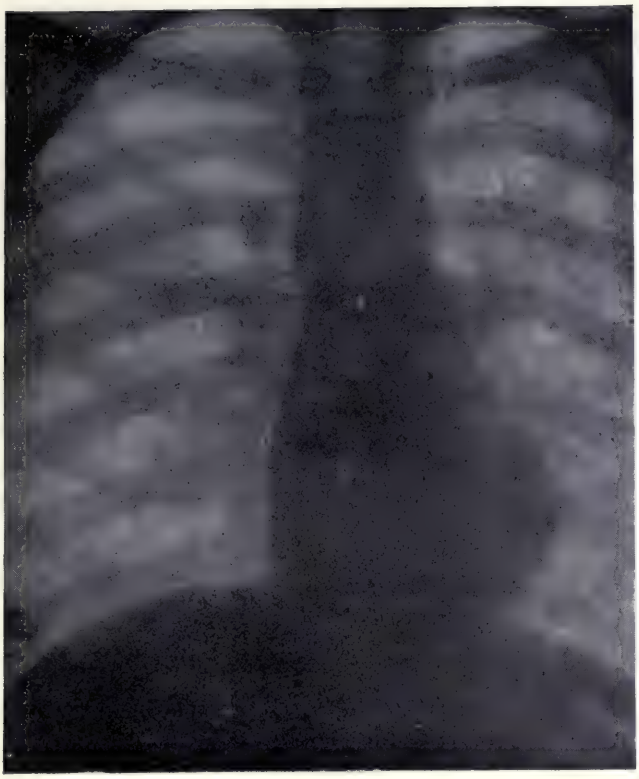


Rad. 1.—Emily D——, æt. 42 years; family history +; cough for 10 years; hæmoptysis about ʒiv on four occasions, the last Nov., 1916; tubercle bacilli +; percussion dulness over both upper lobes; posttussive crepitations at both apices; *Radiogram* shows apical disseminated tuberculosis—old caseating foci in right paravertebral and mid-clavicular areas; on left in paravertebral, mid-clavicular and axillary branches; no signs of cavitation; emphysema below; cardioptosis; ossification of first rib cartilage. After several weeks' treatment in Sanatorium the sputum was free from tubercle.

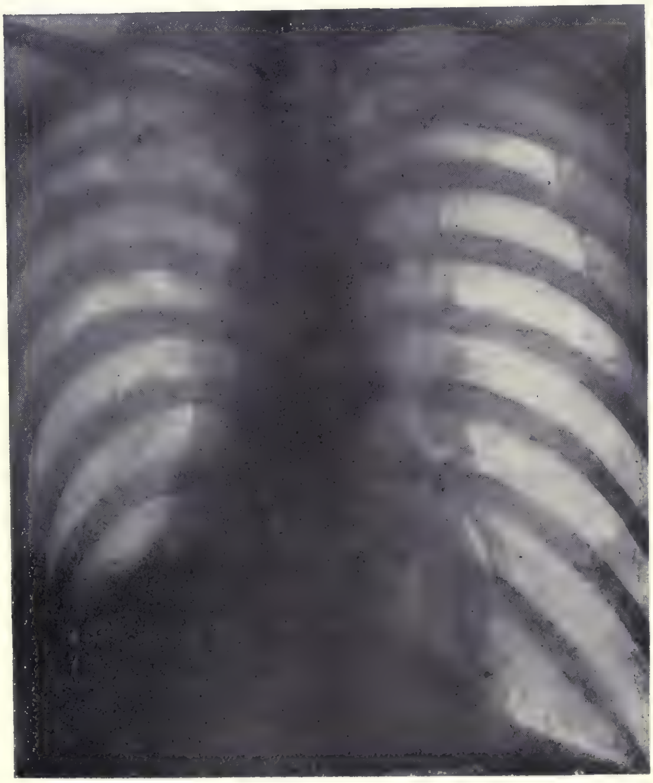


Rad. 2.—J. S——, interlobar phthisis, described in the text.

PLATE 7.

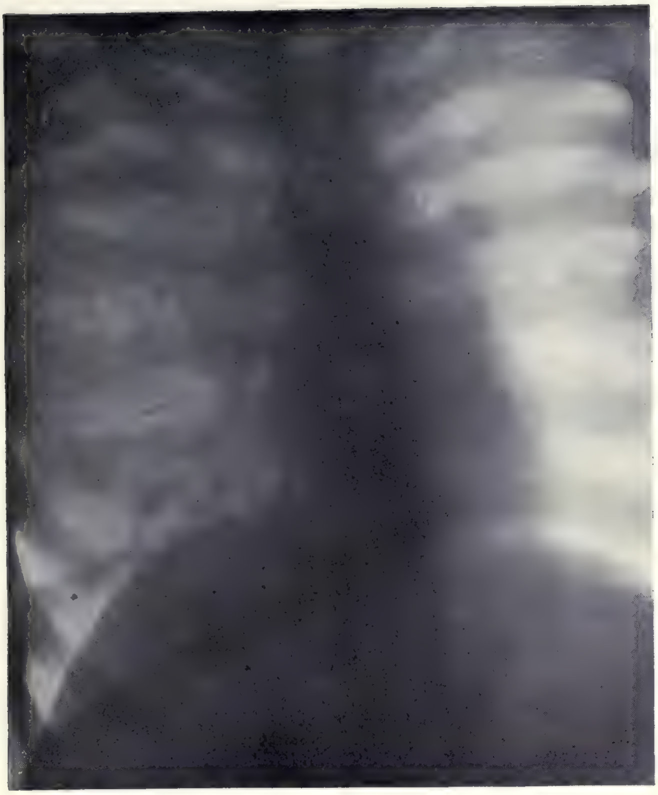


Rad. 3.—Morris R——, disseminated peribronchial phthisis, involving lingula of left upper lobe in particular. Clinically, cough 3-4 weeks; expectoration; hæmoptysis absent; no T.B.; slight deficiency of movement of chest, and impaired percussion note; a few fine crepitations at the end of inspiration at right apex; otherwise, no physical signs. In the radiogram the lingula is packed with foci, and an opacity is visible just beneath the left hemidiaphragm; more apparent on account of the gastric air-sac beneath.



Rad. 4.—Mary W——, arrested apical phthisis, with old fibroid opacities on left side, near sternal end of the first rib; diminished interspaces below due to contraction of chest from costo-phrenic adhesions. During inspiration the lower half of left chest is drawn to the right (see-saw movement). Complete left pleural symphysis.

PLATE 8.



Rad. 5.—Henrietta H——, æt. 20. Clinically, signs of a dry cavity; beneath clavicle no moist sounds. Very anæmic. *Radiogram*, disseminated tubercles of both lungs, passing into caseous form, the separate tubercle remaining isolated, except in right upper lobe. Oldest portion at right apex, with radio signs of consolidation and cavitation.

Rad. 6.— Edward B——, æt 34. Family history +; enlisted November, 1914, discharged January, 1917; was in Sanatorium in 1914. Expectoration now contains bacilli and streaks of blood at times; extensive physical signs in both lungs, especially left; t°, 99° morning, 100° evening; sputum, ʒiii daily; has lost two stones in weight during the last two years. *Radioscope*, right hilar area increased in extent; opacities in both upper lobes; inner half of right half of diaphragm moves badly. Heart displaced to left; left hemidiaphragm immobile. *Radiogram*, patches of opacity in upper lobes, in the lingula; some appear active, others appear fibrotic. Thin interlobular opacities. Heart beginning to pass over to left, exposing vertebral column near diaphragm. Possibly an arrested case, reactivated during military service.

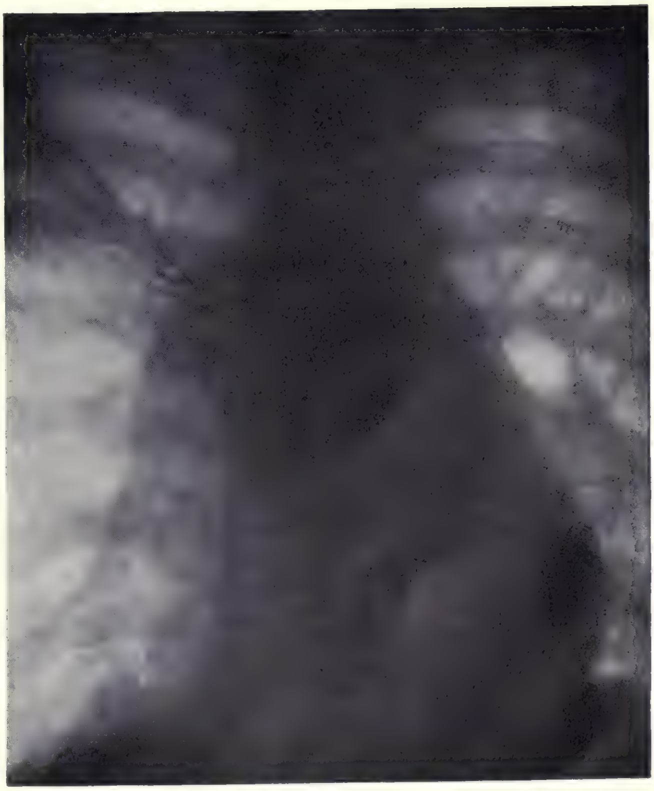
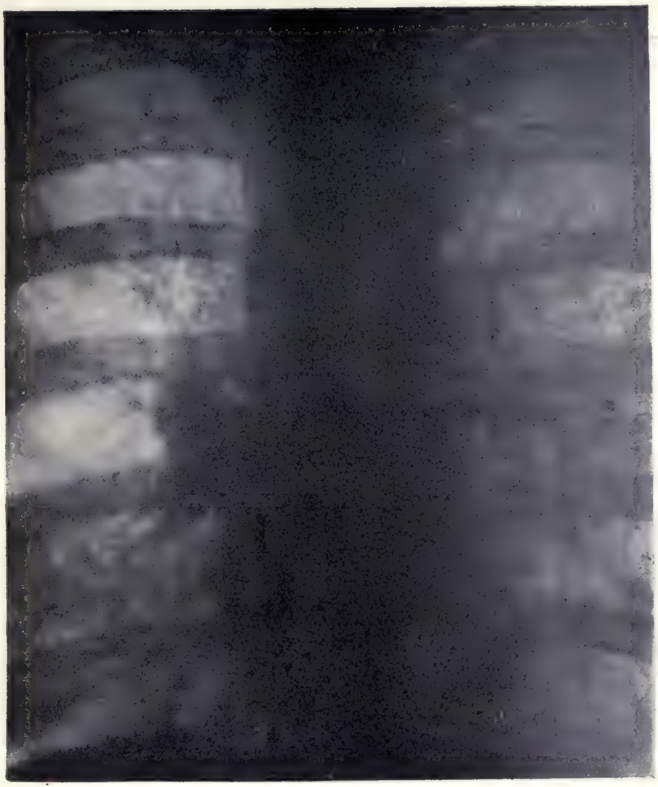
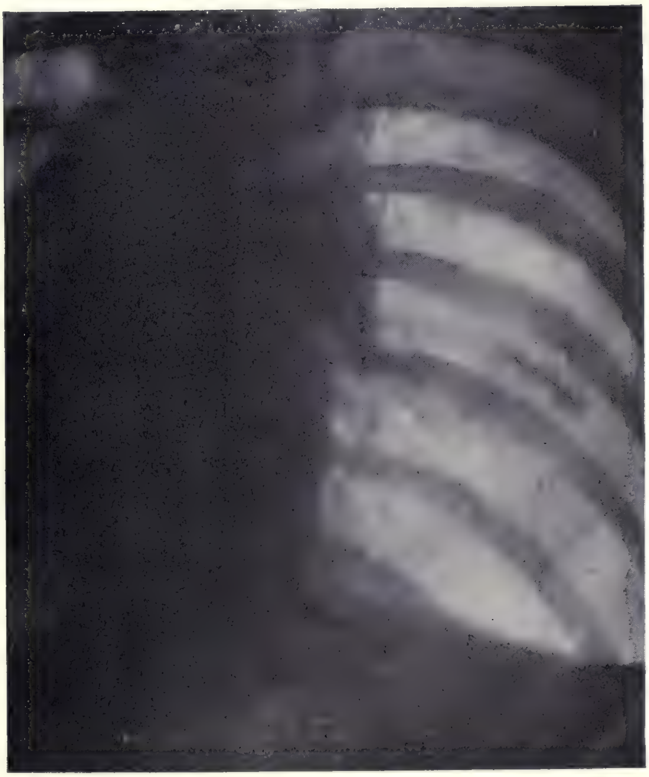


PLATE 9.



Rads. 7 and 8.—Fibroid disseminated tubercle in middle-aged man, suffering from attacks of tuberculous asthma. Bacilli absent in sputum.



The posterior radiogram 8 shows the undulating appearance of the bronchi in the presence of basal œdema after an attack of asthma. Note the fibrosed bronchi (Rad. 7) running to upper lobes and enlargement of right tracheo-bronchial glands.

Plate 10.

obviously proceeded *pari passu* with the dissemination. The older areas are denser, and may assume a racemose form (*racemose tubercle*). They are evidently small periacinous nodules. (Rad. 5.)

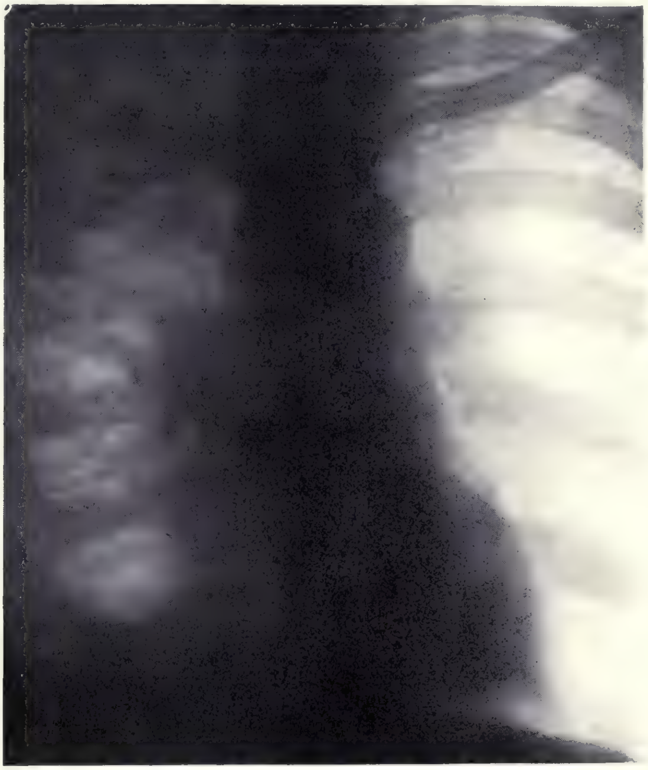
23. When coalescence and fusion of the foci lead to the formation of bronchopneumonic patches, the latter in the process of evolution break down locally to form cavities, and the disease passes into that of the *common open fibrocaseous phthisis*. Where the dissemination has been abundant and fibrosis gains the upper hand, proliferation of connective tissue is exuberant and spreads to interstitial and interlobular areas, producing irregular honeycomb shaped outlines (*vide* radiogram 6.). Displacement of the heart, mediastinum, and trachea to the more affected side follows, and, in addition, a partial or general hypertrophy of the lung which is less involved (*chronic indurative phthisis*).

24. In other cases, evolution remaining progressive, dark discrete patches of caseofibrosis fill the pulmonary fields on the screen, and the accompanying emphysema produces clear intervening spaces. These cases of disseminated fibrosis are frequently accompanied by tuberculous asthma, the attacks of which are sometimes followed by a basal, perhaps unilateral, œdema, in which the tubes assume a *characteristic wavy course*. After an asthmatic attack the fields present a brilliant silvery appearance which may last some weeks, until, in fact, the lung has recovered its elasticity. The sputum is generally free from tubercle bacilli, but may contain the so-called tuberculosis-granules. The final condition then is one of *fibroid disseminated phthisis with emphysema*. (Rad. 7, 8, and 9.)

25. In a fourth class, where the symptoms are milder and the disease is more closely allied to peribronchitis benigna, the caseation and finally fibrosis appear particularly to involve the tubes themselves, so that the bronchial tree is especially conspicuous. (*Bronchitis tuberculosa.*)

26. In a fifth class, the fibrosis is more uniform and affects all the constituents of the lung gradatim ; evolution is continuous, and the final condition is one of *dense fibroid phthisis*, in which the whole of one lung, or a portion of it (generally the upper lobe), appears dark and homogeneous to the screen and plate. If, for instance, the upper lobe of the right lung alone is affected, there may be observed below the dark opacity a very slow continuous growth of fine small opaque foci which gradually increase its area. The rays are quite unable to penetrate the fibrotic tissues, which therefore cast a dense, homogeneous, and non-transparent shadow. The healthy lung passes into a state of general hypertrophy (*phthisis fibrosa densa*). (11.)

Since the present communication has already reached a greater length than was anticipated, we propose to leave the consideration of the bronchitic, bronchopneumonic, pleuritic, true emphysematous, glandular, and traumatic forms for a second article, in which, in addition, the help afforded by the radioscope and radiogram in the *differential diagnosis* of pulmonary tuberculosis will be discussed.



Rad. 9.—Henr H——, æt. 25. Disseminated unilateral fibroid tubercle of right side, with costo-phrenic adhesions and probably residues of pleuritic effusion. In upper lobe note crescentic opacity. Such shadows are not uncommon, and their relation to the formation of cavities is still *sub judice*. Left lung hypertrophied and nearly free.

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(6) Overend. "Lancet," August, 1901.

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A NEW APPARATUS FOR ASSISTING THE SURGEON IN FINDING FOREIGN BODIES LOCALISED BY MEANS OF THE X RAYS.

By Major J. Hall-Edwards, R.A.M.C.

Localisation by means of the X rays, properly and scientifically carried out, gives the position of a foreign body in relation to certain marks made upon the skin with mathematical precision, and failure to find it on the part of the surgeon is proof positive of faulty technique. To secure the best results it is necessary that the surgeon and radiographer act in concert, and that they both fully recognise the importance of accuracy in their methods. Many of the failures in the past have been due to the fact that co-operation has not taken place, and in the hope of obtaining better results in the future, I venture upon a few remarks which I trust will be helpful to those engaged in war surgery.

I find that not infrequently the diagnostic radiograph, which was primarily taken for the purpose of discovering the presence of a foreign body or otherwise, is used by the surgeon as a guide to the foreign body's position, when it is nothing of the sort.

The routine procedure at a military hospital is as follows:—Army Form, W. 3172, is forwarded to the X-ray room and the patient is sent for at the earliest possible moment. On this form is a space which should be devoted to a short history of the case, but as a rule it contains nothing more than "for F. B." and the part to be radiographed. Not infrequently the limb is bandaged for some distance, including the nearest joint, and the point of entrance is indicated to the radiographer by the patient himself.

The photographic plate is placed beneath or above the limb, and a radiograph is taken with the central rays from the tube passing through the entrance wound. On development a piece of shell is seen to be embedded in the tissues near the edge of the plate; this, however, is not its true position, as owing to the divergence of the rays at this point, it must be situated much nearer the middle of the plate than is indicated on the radiograph. I have known operators search for the metal on this evidence with the natural result that failure often followed. In order to prevent this it is my invariable rule to put in my notes, "this foreign body must be localised should the surgeon consider its removal necessary."

The amount of co-operation between the radiographer and the surgeon differs in different hospitals, and in a recent tour of inspection of X-ray departments, I noted that when co-operation was the rule the best results were obtained. Some surgeons appear to resent localisation being made for them by the radiographer. At one of our large hospitals some short time back, a surgeon informed me that he did not care for a foreign body in a limb to be localised, as he preferred to use his own judgment as to its true position, and all he required were antero-posterior and lateral views. Here we are confronted with considerable difficulty, inasmuch as it is not accurately laid down how such views are to be obtained, and, again, it not infrequently occurs that the obtaining of such views is a matter of impossibility owing to the presence of splints, dressings, etc., which cannot be removed, and the inability on the part of the patient to place his limbs in the necessary position. Take the knee, for instance—an a.p. view is a view obtained with the leg placed upon a couch, with the foot pointing directly upwards and at right angles to the couch, but from an anatomical point of view this is not quite correct. A lateral view is obtained by turning the patient on his side and placing the outside of the knee flat upon the plate, or, better still, by keeping the limb in the position mentioned in taking the a.p. view, propping the plate up by the side of the limb at right angles to the couch and taking a radiograph with the tube on the opposite side. Even should this be carried out with the greatest amount of care, there is some possibility that the pictures will not actually and anatomically represent the views ascribed to them. If, however, care be taken that only the central rays from the tube impinge upon the foreign body, accuracy may be obtained, but this is equivalent to making a localisation, and not half so helpful inasmuch as no measurements are recorded. The ordinary a.p. and lateral views are likely to mislead and are anything but accurate, and when a very small piece of shell is present failure to find it may ensue.

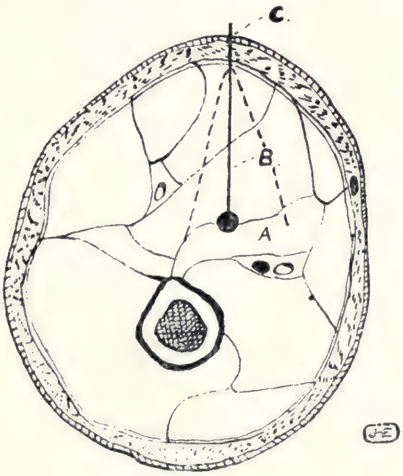

Fig. 1.

In recording my experiences with the X rays in South Africa, in the Archives, January, 1902, in an article entitled "Bullets and their Billets —Experiences with the X rays in South Africa," I alluded to the difficulty presented to the surgeon in finding the foreign body, even when a mark is placed upon the skin exactly over it, and the distance from the skin also given. This difficulty is due to the fact that the marked position of the foreign body on the skin is obliterated immediately the primary incision is made, and from this point the incision may be continued at a different angle to that at which it was commenced.

The diagram (Fig. 1) was published in the paper mentioned, and I venture to reproduce it as it explains how difficult it is to keep straight when once the guiding mark is removed. The diagram represents a section of the thigh with the bullet *in situ* (a), the position marked on the skin (c), the direct line which should be followed by the surgeon (b). The dotted lines, in an exaggerated degree, show the paths which may be taken by the surgeon after the mark has been obliterated by the primary incision. Any deviation from the direct path naturally involves a large amount of extra work and makes the finding of the foreign body a matter of considerable difficulty. This difficulty, in some instances, may be overcome by passing a sterilised needle through the tissues to the bullet and carrying the dissection down by its side. This can only be carried out when the bullet is embedded in a part where large vessels or nerves are not likely to be met with.

I then suggested an apparatus for aiding the surgeon in his search for small foreign bodies (Fig. 2), which consisted of a strip of metal which could be strapped to the limb, to one side of which is fixed an upright (D) carrying a movable arm, at the end of which was a probe (E), which could be slipped up and down in a tube, but which would always keep its point on one fixed spot. This arrangement is fixed upon the limb with the pointer or probe exactly over the marked position (Fig. 3) of the bullet. During the operation the hinged arm carrying the pointer can be moved out of the way of the surgeon, whilst it can be replaced in its proper position at any moment, and if necessary the pointer or probe can be lowered into the wound, so as to show whether or not the incision is being made in the right direction.

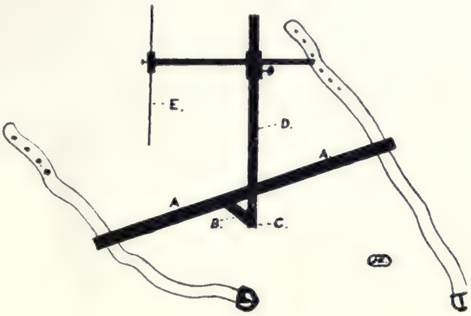

Fig. 2.

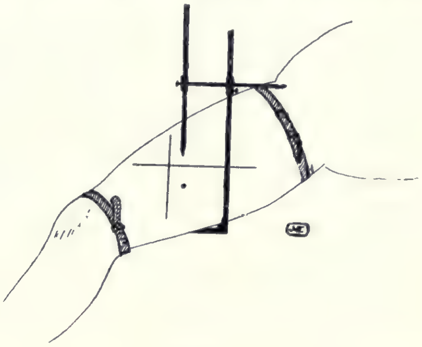

Fig. 3.

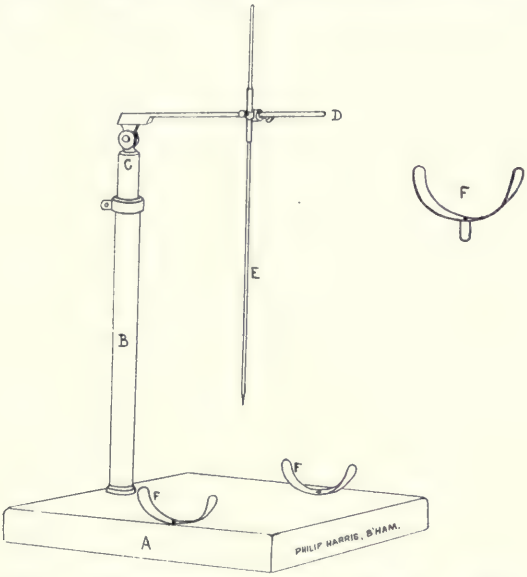

Fig. 4.—Apparatus designed by Major J. Hall Edwards, R.A.M.C., for assisting the surgeon in the finding of foreign bodies localised by means of the X rays. (For description see text.)

Some twelve months back I re-designed this apparatus so as to broaden its field of usefulness (see Fig. 4).

An upright pillar (B) is fixed into one side of the base (A), some 18 ins. square, made of zinc or aluminium, which is capable of being sterilised. To this upright pillar is attached the arm (D), which carries the pointer or probe (E) sliding in a tube to keep it parallel. This can be moved along the arm (D), to or from the pillar, and also be raised or lowered, so that it can be brought opposite the marked position on the skin with ease.

Two holes in the base are for the purpose of fixing various sized crutches (F) for holding the limb or head in position. The arms of these crutches may be provided with straps (Fig. 5), which will allow of their being fixed to the limb, so that in the event of the surgeon having to move the limb from the face of the instrument, he can do so, and at the same time can replace it should he find it necessary to again use the pointer. The limb can then be replaced in its proper position on the apparatus by turning it, so that the lugs attached to the crutches can be replaced in the holes on the base provided for them. In addition to the arm which carries the pointer or probe being hinged, it can also be turned sideways in a collar at the top of the upright pillar and brought back to its original position (see Fig. 5).

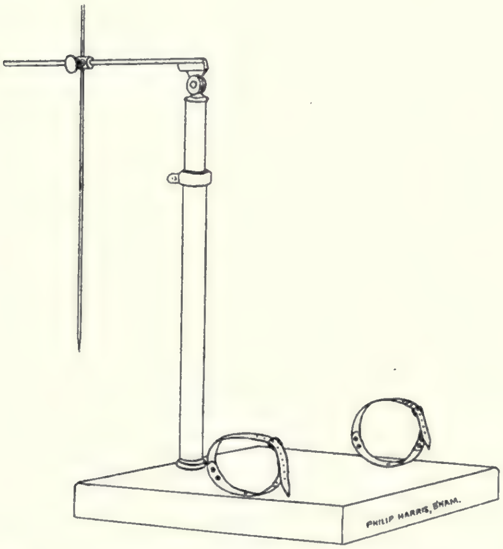

Fig. 5.—Shows the horizontal arm and pointer, or probe, moved out of the way of the surgeon, and the straps for holding the limb attached to the crutches.

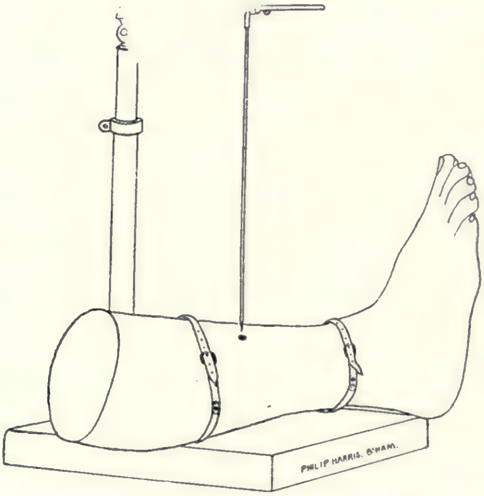

Fig. 6.—Shows limb held in crutches, with pointer above mark on the skin, beneath which the foreign body lies.

The pointer or probe is callibrated so that the distance it is lowered into the wound can be measured. In the instrument proper, the upright pillar is not fixed in the centre of the base but rather to one side, so as to allow for the distance taken up by the holder of the probe, and of the probe being brought over the centre of base, when the arm (D) is at right angles to the pillar, and also to allow of the additional probes (mentioned later on) to be brought into their proper position. If, after removing the limb from the crutches, the pointer be lowered to the measured depth of the centre of the foreign body, the point of the probe will represent in space this position. It is, therefore, obvious that another probe brought at right angles to this point (supported by pillar B), will also represent the position of the foreign body from that particular angle, so that should the surgeon decide that it is better to go for the foreign body from another angle, a second probe can be fixed so as to point to the foreign body, having first set it to touch the point of the first probe.

Fig. 7 explains the method of using the probes in various positions. The upright one is of course the original probe or pointer representing the path of direct rays through the thigh, and with its point resting upon the centre of a bullet embedded in the tissues. Should it be desired to make an incision at any other part of the limb, the subsidiary probes (G and H) are set to touch the point of the vertical probe. It will be obvious that if these probes are withdrawn through their tubes and the limb again placed upon the crutches in its original position, with the vertical probe representing the path of the direct rays pointing to the original mark made upon the skin, that either or both of the other probes when approximated to the skin will point to the bullet from their particular angle, and the distance of the bullet from that particular angle can also be read off from the callibrations marked on the pointers.

As it not infrequently happens that the surgeon prefers to operate from a different angle to the one used in the location of the foreign body, the usefulness of this piece of apparatus will be apparent, and especially so in dealing with foreign bodies located in the head, where the choice of the angle at which the surgeon prefers to operate must be left entirely to him. He has only to indicate where he prefers to make his primary incision, and it is an exceedingly simple matter to so adjust one of the subsidiary probes as to act as a director from this point of view.

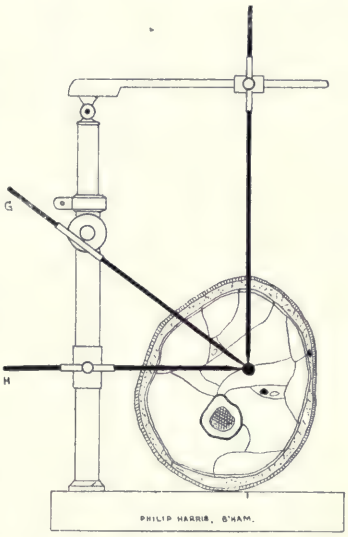

Fig. 7.—Shows section of thigh, held in crutches, with two additional pointers, G and H, set to touch foreign body. When these are withdrawn so as to touch the skin, they will show where the incision is to be made, and the depth of the foreign body from this spot can be read off by means of the callibrations on the pointer.

The instrument is supplied with various sized crutches to support the forearm, arm, leg, thigh, and head. If the foreign body is in any part of the trunk, the trunk can also be laid upon the base and the pointer brought over the marked spot in the same way, the crutches, of course, being removed.

The apparatus will be found exceedingly useful when the foreign body is embedded in the tissues in such a position that large nerves and blood vessels have to be pulled aside to enable the surgeon to get at it, as by lowering the probe into the wound it is quite easy to follow its direction.

I trust that this apparatus will prove of service in war surgery and will help to overcome some of the difficulties which have hitherto been met with in the removal of foreign bodies in difficult positions.

Since writing this paper, my attention has been called to an article in the *American Journal of Roentgenology*, by Major Lewis G. Cole, of New York, in which he has described an apparatus very similar to the one I have designed. I note that he attributes the use of the pointer acting as an indicator to "Jordan." I therefore venture to publish this article, notwithstanding the fact that a somewhat similar apparatus has been described in New York, but I think I can well claim to have first suggested this method of procedure, as my paper appeared in the ARCHIVES no less than 15 years ago. I may say that I have encountered considerable difficulty in getting this apparatus made, owing to the pressure of work entailed by the war, but Messrs. Philip Harris, Ltd., Birmingham, kindly volunteered to undertake the task, and have carried out my suggestions to my entire satisfaction.

ROENTGEN RAYS FROM SOURCES OTHER THAN THE FOCAL SPOT IN TUBES OF THE PURE ELECTRON DISCHARGE TYPE.

BY W. D. COOLIDGE AND C. N. MOORE.

RESEARCH LABORATORY, GENERAL ELECTRIC COMPANY.

Reprinted from the "General Electric Review," April, 1917.

(*Continued from p.* 183.)

"INDEPENDENT" RADIATION.

Metal	Atomic Weight	Intensity of Radiation
Platinum	195·2	100
Tungsten	184·0	91
Molybdenum	96·0	50
Copper	63·6	33
Aluminium	27·0	10

He found, as the table shows, that the efficiency decreases as the atomic weight decreases, and is approximately proportional to it. By calorizing the copper on the surface, or by otherwise covering it with aluminium, or by replacing the copper with magnesium or some metal of still lower atomic weight, it would be possible to still further reduce the roentgen ray production from the surface of the target outside of the focal spot. The method is different in principle from either of the preceding in that it involves no attempt to reduce the intensity of bombardment of the surface by the reflected cathode rays, but rather reduces the efficiency of the roentgen ray production resulting from this bombardment.

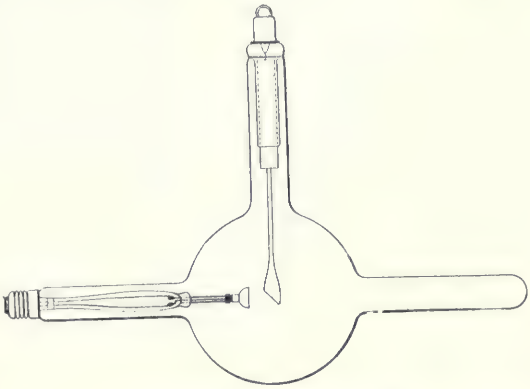

Fig. 16.—Tube in which Target is placed at Right Angles to Length Axis of Tube.

Target placed at Right Angles to the Length Axis of the Tube.

In this method no attempt is made to influence the production of roentgen rays on the surface of the target. The target is merely inserted in the side of the bulb, as shown in Fig. 16, instead of in the usual position, and the rays are then taken from the end instead of the side of the target. As a result, the rays from the body and stem of the target do not affect the roentgenogram, as they are intercepted by the face. This is shown in the roentgenogram, Fig. 17, in which the broadside view of the target is also given for comparison. In this simple form this method would be very effective for work calling for a narrow angle of rays; it would not be effective when the angle is wide enough so that the face of the target no longer intercepts the rays coming from the body and stem.

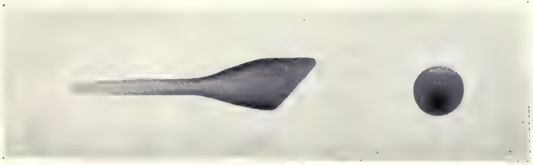

Fig. 17.—Right, Roentgenogram of Target of Tube shown in Fig. 16; Left, Broadside View of Target for Comparison.

Diaphragm Within the Tube, Parallel to the Target and Insulated from It.

This construction is illustrated in Fig. 18. The diaphragm is made of some metal opaque to the roentgen rays, such as molybdenum or tungsten. It may be attached to the cathode, or it may be supported by the glass of the anode arm. In either case the diaphragm will be at cathode potential when the tube is operating, and hence will not be bombarded by the reflected cathode beam. Therefore, it will not of itself be a source of roentgen rays.

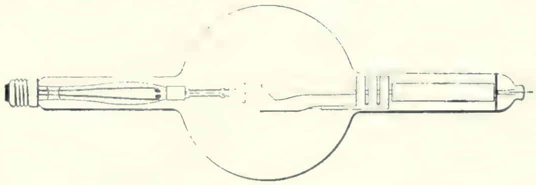

Fig. 18.—Tube having Diaphragm Parallel to Target and Insulated from it.

Fig. 19 shows two roentgenograms of such a target. The lower one is a face view. The diaphragm itself does not show at all in this view, indicating that it undergoes no cathode ray bombardment. The body and stem of the target show through the diaphragm a little, owing to the fact that it consisted of molybdenum only 0·010 in. thick. The upper roentgenogram was made after rotating the tube through an angle of about 120 degrees. It shows that from the inner surface of the diaphragm there is a small amount of roentgen radiation, but this is seen to take place only from that portion of the end of the diaphragm which is in the path of the roentgen rays from the focal spot, and is hence secondary roentgen radiation. The roentgenogram shows that the molybdenum piece not only serves as a diaphragm, but that, by being at cathode potential as it is, it causes some of the reflected cathode ray bombardment to be transferred by electrostatic repulsion from the front to the back of the anode.

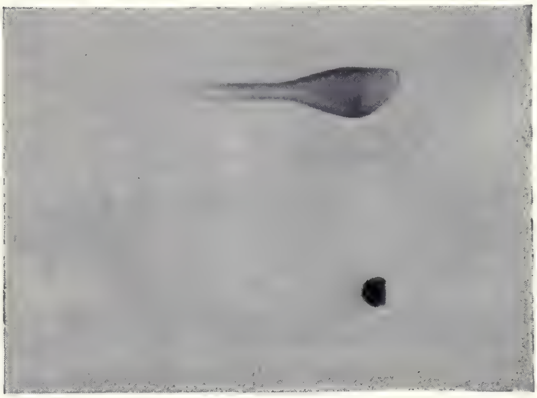

Fig. 19.—Two Roentgenograms of Target of Tube shown in Fig. 18.

Limitations of the Various Methods.

Each of these methods, as applied to the present standard tube, interferes in some way with its general usefulness. The hood, to be very effective, should have a small window for the emergence of the roentgen rays, and this limits the size of plate which can be covered with the tube. The same consideration applies, although with less force, to the internal diaphragm which is insulated from the anode.

The placing of the target at right angles to the length axis of the tube makes the tube awkward to handle. In the simple form it is, furthermore, effective in only the narrow central cone of rays. The tube can, of course, be used to cover a wide angle, but it is only the central portion of the resulting roentgenograph which can profit appreciably by the method.

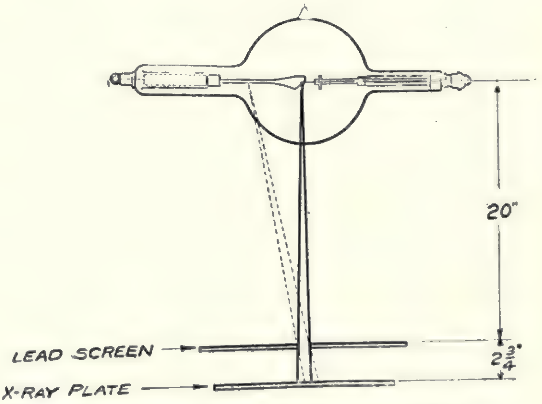

Fig. 20.— Diagram showing Arrangement of Apparatus for Determining Effectiveness of Different Methods.

The placing of the cathode very close to the anode (as close as 2·5 mm., for example) limits the potential which can be used on the tube, at least with present exhaust methods. It would, furthermore, make it necessary to take the roentgen rays out through the cathode structure. The placing of the cathode too close to the anode would also make it difficult to maintain a constant filament temperature, that is, if the target was allowed to become incandescent.

The use of a metal of low atomic weight for the surface of the entire target (exclusive of that needed for the focal spot) and stem, is practicable only in case the target is not to be allowed to become very hot, for the reason that there is no metal of low atomic weight which is sufficiently refractory. (Among the non-metallic elements, carbon might possibly be used, but it would render the exhaust more difficult, and at high temperature it furthermore alloys readily with tungsten.)

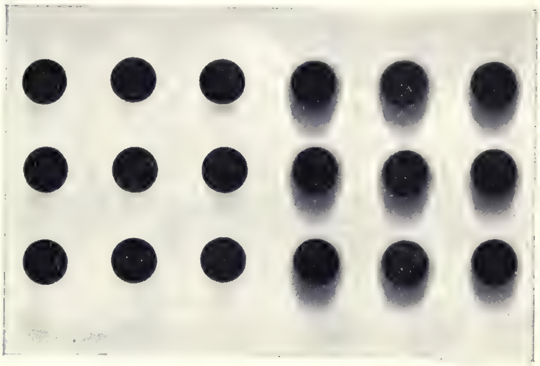

Fig. 21.—Left, Roentgenogram through Holes in Lead Plate with Hooded Target (Fig. 8); Right, Standard Tube.

Relative Test of Effectiveness of the Various Methods.

Of course the pinhole-camera roentgenograms themselves give some idea of the effectiveness of the various methods. Nevertheless it is difficult to say from an inspection of them which method would give a tube that would make of a given object the best roentgenogram. For this reason a test method, which has been described before,* and which is illustrated in Fig. 20, was resorted to. The test object is a lead plate with nine small round holes in it, and is placed at a distance of $2\frac{3}{4}$ in. from the photographic plate. The tube is placed with its focal spot 20 in. from the X-ray plate. No external diaphragm or cone is used. All exposures are made with the same voltage, current and time, and the same development is used throughout. If all of the roentgen rays came from the focal spot, the radiogram would, in each case, be a series of sharply defined circular areas. Any rays coming from the body and stem of the target tend to produce a halo on one side of each of these circles.

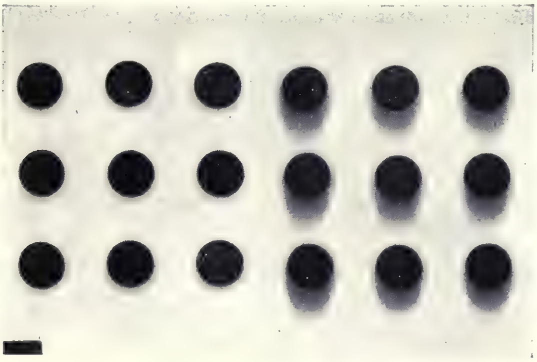

Fig. 22.—Left, Tube with Target placed at Right Angles to Length Axis (Fig. 16); Right, Standard Tube.

The roentgenogram to the right in Fig. 21 was made with the standard tube and that to the left with the tube having a hooded target.

Fig. 22 shows a similar comparison between the standard tube and the one with the target set in to the side of the bulb, as in Fig. 16.

*W. D. Coolidge, Am. Journal of Roentgenology, Vol. II, p. 885 (1915).

Fig. 23 is a test of the standard tube *versus* the one with the internal diaphragm, as in Fig. 18.

It will be seen that, according to this test, the tube with the internal diaphragm is the best of those tried. The tube with the copper-backed target was not included. The one with the cathode placed very close to the anode, as in Fig. 13, was not included for the reason that, while from the body and stem of the target it gave the least radiation of any of the tubes, the design of this particular tube was not adapted to the test.

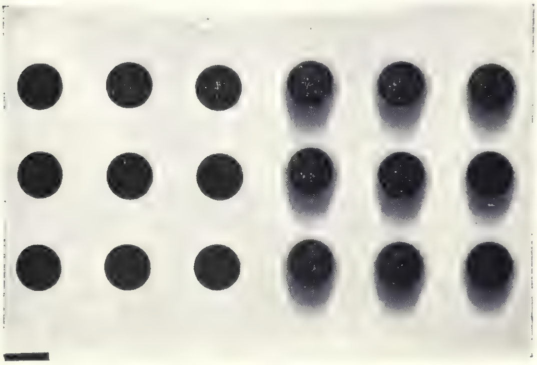

Fig. 23.—Left, Tube with Internal Diaphragm (Fig. 18). Right, Standard Tube.

Comparative Test of the Tube with Internal Diaphragm Against the Standard Tube in Medical Roentgenography.

The test with the lead plate with the holes was recognized in the beginning as an artificial one, the results of which might be difficult to interpret in terms of medical work. It seemed to be a safe guide, however, as to the relative effectiveness of the different methods.

Having determined in this manner that, of the various experimental tubes made, the one with the internal diaphragm should be looked to for the best definition in roentgenography, the next problem was to show by actual tests whether roentgenographs of medical subjects made with the internally diaphragmed tube were appreciably better than those made with the standard tube.

A pair of tubes was chosen, one with and the other without the diaphragm, with the same size of focal spot (as determined by the pinhole-camera method).

The difference found in the pairs of plates made with these tubes of various parts of the body, was so small that it proved very difficult to show beyond reasonable doubt that there was really *any* perceptible difference. Failure to get absolute immobilization of the part in question with either roentgenogram was enough to bring a decision in favour of the other plate. It was finally found that whatever difference there is could better be shown by roentgenograms of a dried skull. This test appears to be more searching than that with a live subject, for the

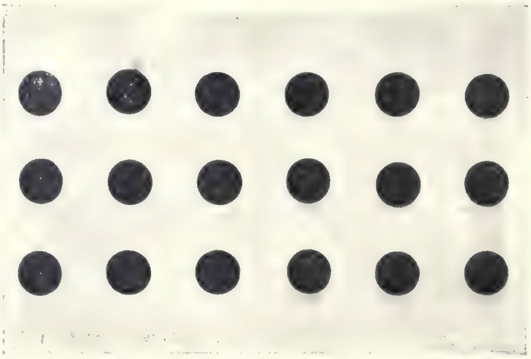

Fig. 24.—Left, Tube with Internal Diaphragm. Right, Standard Tube. Exposure, 10 Milliampere Seconds.

reason that the smaller amount of secondary radiation from the dried skull gives better definition and hence puts the observer in a favourable position to notice differences ascribable to the cause in question. To further this same end, a very small size of focal spot was chosen for the test. The most important thing of all was to use exactly the same voltage on both tubes. This was accomplished by the use of auto-transformer control of the high-voltage transformer and by the use of a stabilizer in the filament circuit.

The difference between such a pair of plates is so small that it at first escaped detection. It would be lost in reproduction. Such a pair of plates has been submitted to quite a number of prominent roentgenologists, and some of these have chosen the right plate and some the wrong one as the work of the tube with the internal diaphragm.

Explanation of the Smallness of the Gain Made in the Quality of the Roentgenogram by Reducing the Effect of the Radiation from the Target outside of the Focal Spot.

The explanation lies in the sensitiveness curve of the photographic plate and in the narrow range of plate densities involved in roentgenograms of the human body. This is easily proved by going back and making further roentgenograms of the lead plate with the holes. If, instead of greatly over-exposing the area of the plate under the holes, so as to bring out the halos strongly, the exposure is so timed as to bring the density of this part of the developed plate only to the maximum density found in actual roentgenograms of the human body, it becomes difficult to see the halos. This is illustrated by Figs. 24 and 25. These were made with the pair of tubes in question, one with and one without an internal diaphragm, and with the same technique employed in Figs. 21, 22, and 23, except that the exposure, instead of being 37.5 milliampere seconds, was 10 in Fig. 24 and 1 in Fig. 25.

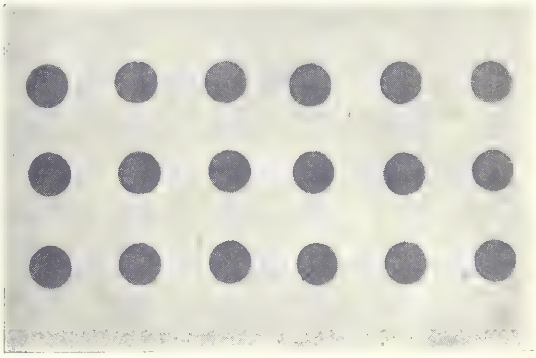

Fig. 25. Left, Tube with Internal Diaphragm. Right, Standard Tube. Exposure, 1 Milliampere Second.

Conclusions Concerning the Importance of the Role Played by the Rays from the Target, Outside of the Focal Spot, in Medical Diagnosis.

With the present roentgenographic technique, the part played by these rays seems to the writers to be too small to warrant the use of any one of the methods described for minimizing it, that is, with the present standard type of tube.

In fluoroscopy, comparative tests have not yet been made between the standard and the internally diaphragmed tube; but it seems most probable that the situation is not essentially different here from what it is in roentgenography.

REVIEW.

The Emission of Electricity from Hot Bodies. By O. W. Richardson, F.R.S. Longmans, Green & Co. 1916. Price, 9s. 6d. net.

The introduction of the Coolidge tube has brought before X-ray workers the phenomena attendant upon the production of ionisation by incandescent solids. Prof. O. W. Richardson deals with the subject at length in his recent contribution to the series of "Monographs on Physics," under the general editorship of Sir J. J. Thomson and Dr. Horton. A careful study of this work will be of value to all interested in the future developments of the new X-ray tube.

At the outset it may be stated that Prof. Richardson does not deal with the practical applications of thermal ionisation, but confines his attention to the more purely experimental and theoretical aspects. The book, while primarily intended for the research worker, nevertheless presents a very complete survey of the experimental foundations of the subject from a non-mathematical point of view; other chapters, which are more theoretical, will appeal principally to the physicist. Much of the present day knowledge of this branch of physics is due to the extensive investigations of Prof. Richardson himself, and the volume forms a very complete summary of his researches, together with a record of the results of other workers in this direction.

Historically the subject is not new, for the power of hot bodies to destroy the insulating property of air has been known for nearly two centuries, while in the nineties Fleming carried out many observations on the Edison effect in glow-lamps. The stimulus for a more complete investigation of the phenomena was not, however, provided until Sir J. J. Thomson developed his theory of ions in relation to the conduction of electricity through gases. Thomson soon showed, by measurements of the ratio of the electric charge to the mass, that the negative ions emitted by hot bodies were only about $\frac{1}{1800}$ of the size of the hydrogen atom, and that the positive ions were invariably of atomic or molecular dimensions.

In experimental investigations an electrically heated filament is usually employed in the case of metals, while for salts or other bodies, which cannot be obtained in this form, the material is frequently supported on a strip of platinum heated to the required temperature by the passage of a suitable electric current. The phenomena of thermal ionisation are very much complicated by the presence of gases, particularly those absorbed by the metallic parts of the apparatus, and in order to overcome the difficulties so introduced the heated filament is usually enclosed in a glass vessel, which is first thoroughly exhausted and is then refilled with any desired gas at the required pressure. Thermal ionisation effects are not confined to experiments in which there is a vacuum or gas under reduced pressure, for, in some cases, very large ionisation currents, of the order of an ampere, have been obtained in nitrogen at atmospheric pressure; the phenomena, however, are very complicated under such conditions. The production of the initial vacuum calls for much care, and it is necessary, while exhausting, to heat the complete apparatus for a prolonged period in a vacuum furnace to just below the softening point of the glass; in addition the metal parts must, at the same time, be subjected to cathode ray bombardment, in order to liberate the last traces of gas. Many of the anomalous results obtained in early experiments, and discrepancies in the quantitative results of later investigations, are probably due to the presence of small quantities of residual gas. A similar process is employed in the evacuation of the Coolidge tube, while the vagaries of the ordinary X-ray tube are generally to be attributed to the evolution and absorption of gas within the bulb. The ionisation currents produced are detected by the use of an auxiliary electrode within the bulb in proximity to the heated body, and are measured by the aid of electroscopes, electrometers, or other current measuring apparatus. The temperature of the filament or strip is obtained by means of an optical pyrometer or indirectly by observations of its electrical resistance, the latter being the more usual way.

To obtain a current between the filament and the auxiliary electrode it is necessary to subject the ions to an electric field. This is produced by the application of a potential difference between the filament and the electrode, and the direction in which the field is to be applied is dependent on the nature of the ionisation, positive or negative, which it is desired to observe. The general effect of increasing the applied field is to increase the current between the electrodes. This increase does not take place indefinitely, for a point is eventually reached when all the ions liberated from the hot body pass across the intervening space to the opposite electrode; further increase of the field produces no further rise in the current, which is then said to be saturated. Another effect may, however, be manifested; the velocity of the ions increases with the field, and under certain conditions of pressure of the surrounding gas may be sufficient to produce additional ions by the collision of the original ions with the gaseous molecules, and a continued increase of current be thereby obtained. The attainment of saturation is occasionally masked by the effect just described.

The electron theory of metallic conduction assumes the presence in the metal of free electrons which are in a state of rapid motion corresponding to the movements of the molecules of a gas. As the temperature is increased this motion becomes more violent, and it is conceivable that at sufficiently high temperatures the energy may be great enough for some electrons to escape from the surface of the hot body. In Chapter II, Richardson, in the first place, develops this theory on a thermodynamical basis, and then proceeds to examine the resulting consequences of the theory. The escape of electrons will proceed whatever the nature of the surrounding gas or even in a vacuum. The resulting currents will, however, be considerably modified according to these conditions; and in the succeeding chapters the influence of temperature and of the surrounding gas is fully dealt with from both theoretical and experimental aspects. After initial disturbing factors have been eliminated it is shown that the emission of ions increases enormously with rise of temperature. The effect of the surrounding atmosphere and also of occluded gas is very marked, but the experimental results are complicated and no generalisations are at present possible. The case of tungsten is of particular interest owing to its importance in the construction of X-ray tubes, electric lamps, and valves for wireless telegraphy; some pages are devoted to the investigations, by Richardson and by Langmuir, of this metal. Much of the difficulty encountered is no doubt due to the occurrence of chemical reactions at the high temperatures dealt with. An interesting theoretical point has been raised in this connection, namely, as to whether chemical action is an essential agent in the production of ionisation. Richardson concludes, after summarising the available data, that such is not the case in general, although it may hold for some materials such as the alkali metals. The evidence strongly points to a physical origin for the ions emitted from a pure refractory metal, for example, tungsten, when heated *in vacuo*.

The emission of positive ions presents a different series of phenomena from those of the electron emission previously considered. Two aspects are apparent on examination of the experimental results, firstly, the true positive emission from the hot metal, and secondly, that due to the presence of a gaseous atmosphere. The first, in marked contrast to the emission of negative ions, decays with time, apparently without limit, and further, the effect is best studied at relatively low temperatures, partly due to the very rapid rate of decay associated with the higher temperatures and partly owing to the masking effect of a large negative emission.

Other chapters deal with the thermionic emission from salts and with the ionisation phenomena associated with chemical action. These both present features of practical interest in connection with lime cathodes and the enhanced thermal ionisation from tungsten and other metals, to which small quantities of a second metal have been added.

Throughout the book copious references will be found to the original papers consulted, and this feature will commend itself to those wishing to study any particular branch of the subject in greater detail.

W. F. H.

NOTES AND ABSTRACTS.

RADIOGRAPHY.

Radiography of Fistulous Tracks after Injection of Bismuth Paste, as a Means of Correcting Errors of Diagnosis.—EMILE G. BECK (*Archives d'Electricité Médicale*, June, 1917).—The author has used a paste of 33 per cent. bismuth subnitrate and 67 per cent. sterile vaseline to inject into sinuses, abscesses and fistulæ, and so make them visible by X rays. He shows that this oily and liquid material penetrates into the deepest recesses of any pocket or false passage. He insists on the value of a stereoscopic radiograph being obtained, and quotes several convincing cases in which this procedure has corrected previous false diagnoses, and has so paved the way to successful treatment and cure. He disposes of the objection that the paste may block a discharging cavity and so cause retention of pus; this has never happened in his experience of some hundreds of cases; moreover, the injection itself led to rapid recovery in quite a number of the cases examined.

N. B.

RADIO-DIAGNOSIS.

The Roentgen Diagnosis of Metastatic Malignant Disease of Bone, with Special Reference to the Spinal Column.—G. E. PFAHLER (*American Journal of Roentgenology*, March, 1917, p. 114).—Discussing the general characteristics of metastatic carcinoma of the spinal column, Pfahler first describes an osteoclastic process, which consists in the destruction by the disease, wherever located, of the lime salts of the normal bone. This may take place extensively, and be sharply localised, or it may be widely distributed through the body of a vertebra or through the bodies of all the vertebræ. This destructive process is generally very irregular in outline, giving the bone a worm-eaten appearance. If this softening process involves a large portion of the vertebra it leads to compression, because of the weight of the body, and the height of the body of the vertebra is decreased. This is one of the most characteristic signs. The most common site of the disease is in the lower dorsal and upper lumbar vertebræ.

The second general process observed by Pfahler is the osteoplastic. Here, true sclerosis or calcification takes place, and, like the areas of destruction, may be distributed anywhere through the body of the vertebra, or in the processes, or may involve the entire spinal column. This sclerotic process is probably an indication of nature's attempt to isolate the disease, and is most frequently found in cases that develop very slowly and in which the malignant process is not especially destructive.

Very frequently the osteoclastic and osteoplastic processes are found combined, each process being irregularly located in one vertebra or throughout the vertebræ of the entire spinal column.

The differential diagnosis between this condition and osteo-arthritis, primary tumours of the spinal column, metastases of hypernephroma, and melanoma, is fully discussed

In Pfahler's experience, the most frequent location of the metastatic process next to the spinal column seems to be in the head of the humerus, about the shoulder joints, and in the neighbourhood of the hip joints.

The conclusions arrived at by the author are as follows:—

Metastatic carcinoma involving bone is much more frequent than is generally recognised, and probably in the advanced stages occurs in nearly 20 per cent. of the cases.

The metastasis to the spinal column occurs in the order of frequency from mammary carcinoma in women, or prostatic carcinoma in men, carcinomata of the stomach, and of the thyroid.

Rheumatic pains, occurring in the presence of malignant disease, should always suggest metastatic carcinoma in the spinal column or other bones, and demand a thorough X-ray examination.

The prognosis of metastatic carcinoma of the spinal column or other bones is very bad, but not absolutely hopeless, and there may still be considerable prolongation of life, with hope and comfort, even after the disease has become very extensive.

A healing process has been observed in metastatic carcinoma of bone.

R. W. A. S.

Observations on the Roentgen Appearances of Osteomyelitis.— R. Hammond (*American Journal of Roentgenology*, March, 1917, p. 107). —Discussing the radiographic appearances in atypical cases of pyogenic osteomyelitis, the writer says it may be confused with certain stages of tuberculosis and syphilis.

Tuberculosis, he says, usually produces rarefaction of bone throughout a joint, in which the cortex is affected as well as the softer portion of the bone. Conversely, syphilis usually results in a deposit of hard, dense bone just beneath the periosteum. Both of these characteristics may be found in osteomyelitis, giving rarefaction combined with over-production of cortical bone or periosteum. In the case of osteomyelitis the overgrowth is more excessive and irregular in outline than is seen in syphilis, and the rarefaction is usually more definite and circumscribed than is found in tuberculosis. A bone tuberculosis which is complicated by secondary infection from pyogenic organisms may give the typical picture of a frank osteomyelitis.

R. W. A. S.

Roentgen Diagnosis of Gastrocolic and Duodenocolic Fistulæ. — M. P. Burnham (*American Journal of Roentgenology*, April, 1917, p. 173).—The author reviews the literature of previously recorded cases of these somewhat rare conditions, and describes in detail the clinical, radioscopic, and operative findings in two cases of his own, the first due to primary carcinoma of the splenic flexure with fistulæ communicating with the stomach, and the second due to primary carcinoma of the hepatic flexure with a fistula communicating with the duodenum.

R. W. A. S.

Renal and Ureteral Stone Symptoms in Spondylitis.—E. S. Blaine (*American Journal of Roentgenology*, March, 1917, p. 122).—The author refers to the not unusual condition of things where a physician sends a patient showing clinical symptoms of renal calculus but in whom the X-ray findings are negative. His paper, however, refers more particularly to a group of cases clinically simulating kidney stone but with no stone shadows, but showing osseous changes at the edges of the bodies of the lumbag vertebræ, especially the upper ones.

These changes are revealed by appearances which are recognised as indicating spondylitis, and vary in degree from a slight squaring of the corners of the vertebral bodies, or "rimming," to the marked "hook" and "spur," and even "bridge formation," known as spondylitis deformans. Other cases, however, may show very distinct and clear cut erosions of the lateral portions of the bodies. In cases with symptoms of renal calculus, but with negative X-ray findings so far as stone, but showing these bony changes, the author thinks it logical to assume that these changes may be the causes of the pain as well as of other symptoms more or less characteristic of stone. He says, however, that these X-ray findings are not necessarily complete diagnoses, for there are other conditions which can only be revealed by the cystoscope, pyelo-radiography, etc.

Careful search should always be made, not only for stone shadows, but for all other signs of abnormality, such as those just considered. Sharpened corners often indicate an early stage, or perhaps the vertebral bodies are only squared or their height lessened. The progressive changes from early hypertrophic spondylitis to advanced spondylitis deformans are illustrated both by radiographs and by diagrams. R. W. A. S.

RADIOTHERAPY.

Rhinoscleroma and the Roentgen Ray.— G. M. Mackee (*American Journal of Roentgenology*, April, 1917, p. 180). —For the treatment of this condition the author advises, if the disease is limited to the nasal alæ, unfiltered rays directed into the nasal orifices. Two or three doses of from H $\frac{3}{4}$ to H 1 (at skin distance), Benoist 9-10, usually effect a cure in such cases. If the disease is extensive, he advises dividing the nose into several areas for the purpose of cross-firing, each area receiving H 1½ to H 2 (at skin distance), Benoist 9-10, filtered through 3 mm. of aluminium, every four to six weeks.

In addition, a radium plaque may be placed against the hard palate and gamma rays administered. Several, perhaps 8 or 10, series of cross-fire treatments may be required to produce the desired result in extensive and long standing cases. The treatments should be given every four weeks.

Lesions in the nose, at the posterior nares, or in the pharynx, will usually disappear as a result of deep therapy applied to the nose. If necessary, this treatment may be supported by the application of radium to the pharyngeal walls, or X rays may be applied to these parts through a metal mouth tube.

R. W. A. S.

Improved Cancer Prognosis Justified by Deep Roentgen Treatment.—A. F. Holding (*American Journal of Roentgenology*, April, 1917, p. 183).—From the experience of over two thousand cases of tumours and allied conditions, the author is of the opinion that the following is the most suitable form of treatment:—

I. Benign Operable Tumours.

(*a*) *Cutaneous.* — Warts, papilloma, xanthoma, fibroma of the skin: Electrolysis when lesions are small and on accessible surfaces of the body. Keratosis: Trichloracetic acid. Nævi: Radium, X rays, Kromayer lamp, CO_2 snow. Keloids: X rays, radium.

(*b*) *Subcutaneous.* — Lipoma, chondroma, osteoma, adenoma, cystadenoma, myxoma: Excision.

Adamantinoma: Radium, X rays. Myoma uteri: When the tumour is not growing rapidly, does not cause kidney or heart blockade, does not block the pelvis; when the patient refuses operation, or is a poor operative risk on account of anæmia, diabetes, nephritis, bronchitis, arteriosclerosis, myocarditis: X rays, radium.

When the tumour is growing rapidly, is of the sub-mucous polypoid type, or an adenoma, or infected, degenerated, or suspected of malignancy: Radical operation.

Exophthalmic goitre: X rays, radium. Adenitis (tuberculous): X rays, radium.

II. Malignant Tumours—Operable or Inoperable.

(*a*) Lesions which respond to X-ray or radium treatment.

Basal cell epithelioma, adenocarcinoma of ovary, carcinoma testis of teratoid origin, mammary carcinoma, embryonal carcinoma, lymphosarcoma, giant cell sarcoma, infectious granuloma, thymoma, myxoma, endothelioma, mixed tumours of parotid, pseudo-leukæmia (Hodgkin's), leukæmia.

Treatment indicated: X rays or radium, with or without surgery and effulgeration.

(*b*) Lesions which do not respond to X-ray or radium treatment or give only palliation.

Carcinoma of abdominal viscera, squamous cell epithelioma, carcinoma uteri, spindle-cell sarcoma, alveolar carcinoma, osteosarcoma, melanoma, hypernephroma.

Treatment indicated: Radical surgical removal by bloodless methods, where possible. Post-operative radio-active treatment.

As for cases of hopeless malignant tumours, the author reports that in some the symptomatic recoveries have been remarkable, and in this article he has selected and illustrates a typical case of lymphosarcoma, alveolar carcinoma of the breast, adenocarcinoma of the ovary, carcinoma testis of teratoid origin, and embryonal carcinoma, each case illustrating a class in which he has found X rays, as a rule, to act favourably.

R. W. A. S.

The Treatment of Hyperthyroidism.—G. W. Grier (*American Journal of Roentgenology*, June, 1917, p. 300).—The author finds that hyperthyroid cases respond to roentgen treatment according to the length of time the disease has been present, and not according to the severity of the symptoms. Within limits, one might say that the more severe the symptoms the more prompt will be the recovery, and this is of importance, as these cases are bad operative risks.

The two factors which appear to have the greatest bearing on the prognosis under X-ray treatment are the length of time the condition has existed and the softness of the enlargement. In a general way, the longer the disease has been present and the harder the gland, the greater will be the difficulty in producing a satisfactory result.

The same factors also determine largely the length of time the patient will require to be under treatment. Soft goitres, which have only been present about a year, usually recover in two or three months. Hard goitres of long standing seldom show much improvement in less than six months.

Grier advocates the routine examination of the mediastinum in all thyroid cases previous to treatment, and deprecates hurrying the treatment or the giving of massive doses owing to the liberation of thyrotoxins.

Under X-ray treatment, the first improvement is noted in the nervousness and pulse rate, followed by an increase in weight and gradual amelioration of the other symptoms.

The method of treatment which Grier advises for the different types of cases is as follows:—

Mild cases of simple hyperthyroidism may be treated medically or by X rays. Medical treatment will succeed in the majority of cases, roentgen treatment will be satisfactory in practically all of them. Operation is unnecessary and improper in this type.

In acute exophthalmic goitre X-ray treatment is the most satisfactory. Medical treatment is inadequate and surgery unnecessary and often dangerous. If untreated, these cases either die or merge into the next type.

In chronic exophthalmic goitre the choice lies equally between X rays and operation. The former is apt to be slow, but there is not so much danger of producing a subsequent hyperthyroidism as by operation.

In cases where hyperthyroidism develops in an old goitre X-ray treatment is only palliative. The danger of producing myxœdema is also greater here, and the proper treatment is surgical. R. W. A. S.

INSTRUMENTAL.

A New Couch for Aseptic Operating under Radioscopic Control. — ANTONIO COPPOLA (*Radiologia Medica*, IV. 7-8, 1917). — The author calls attention to the advisability of the installation of an X-ray operating theatre in all the larger hospitals, and describes in detail the measures whereby he overcame all the difficulties in fitting up such a room in the Hospital dei Pellegrini. The points on which he lays most stress are the following:—

A collapsible hood, easily adjustable and movable, has been fitted to the head of the table, with a small electric bulb within. By this means the anæsthetist can work in light and comfort, without interfering with the darkness required at times by the other people in the room.

A detachable American cloth cover is put over the table. This can be readily removed for thorough cleaning and sterilization without the trouble of disconnecting the wires and fittings of the tube.

The room is small, and to avoid overcrowding and expense the coil, switchboard, etc., have been left in the X-ray room and wires led along the corridors to the tube belonging to the table. A small switchboard on the theatre wall is controlled by the radiologist or his assistant, who is thus not in the operator's way. Very little efficiency is lost by this manœuvre and excellent results are obtained.

N. B.

Owing to the increased cost of labour and material the Publishers regret that they are compelled, as a temporary measure during the course of the war, to raise the annual subscription to 30/- a year, and single copies to 3/-, from January 1st, 1918.

PUBLICATIONS RECEIVED.

Books.

Electrothérapie. Par le Docteur Thomas Nogier. 2me Edition. Paris: Librairie J. B. Bailliere et Fils.

Radiography and Radiotherapeutics. Part I. By Robert Knox, M.D., M.R.C.S., L.R.C.P. London: A. and C. Black.

Roentgen Technic (Diagnostic). By Norman C. Prince, M.D. St. Louis: C. V. Mosby Co.

Journals.

American Journal of Electrotherapeutics and Radiology, September, 1917.

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American Medicine, September, 1917.

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Boston Medical and Surgical Journal, October 4th, 18th, 25th, 1917.

British Journal of Dermatology, July-September, 1917.

Bulletin of the Johns Hopkins Hospital, October, 1917.

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Cleveland Medical Journal, Oct., 1917.

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Maryland Medical Journal, Oct., Nov., 1917.

Medical Journal of Australia, Aug. 11th, 18th, 25th, Sept. 1st, 1917.

New York Medical Journal, Oct. 6th, 13th 20th, 27th, Nov. 3rd, 1917.

New York State Journal of Medicine, October, 1917.

Norsk Magazin for Lægevidenskaben, November, 1917.

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Quarterly Journal of Medicine, Oct., 1917.

Revista Médica de Málaga, Oct., Nov., 1917.

Southern Medical Journal, Oct., Nov., 1917.

Ugeskrift for Læger, Oct. 18th, 25th, 1917.

NOTICES.

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Communications and illustrations from American contributors may be sent to Messrs. REBMAN COMPANY, 141-145, West Thirty-sixth Street, New York City.

All radiographs and photographs must be originals, and must not have been previously published. Drawings should be supplied on separate paper.

Owing to the scarcity of paper the Publishers are reluctantly compelled—as a temporary war measure—to reduce the number of free reprints of Papers to twenty-five.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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THE FUTURE OF RADIOLOGY AND ELECTROTHERAPY.

It has become a custom with many individuals and corporate bodies at the end of the year to review the past year's work. This admirable custom is frequently fruitful in several ways. It explains the limitations of the year's work, its failures, and is productive of at least one good end. It encourages the formulation of good resolutions for the coming year. We, therefore, in accordance with this custom, have reviewed our past and have registered resolutions and plans for the future. The latter alone interest our readers. We shall briefly indicate the result of our deliberations so far as the future of the Archives of Radiology and Electrotherapy is concerned.

The use of radiations in medicine and commerce is daily extending. In the former many important advances have of late been made; many more are bound to follow in their wake.

In commerce and scientific development the strides made have rapidly followed one another. In the detection of contraband in cargoes, apparently innocent, X rays have become a "searchlight" of great power. In America rays are used for the destruction of certain larvæ which attack tobacco leaves. The use of X rays in the examination of metal for the detection of flaws, and faults in shells and other munitions of war, clearly indicate a great expansion of the field for radiographic research. Aeroplane parts might with advantage be subjected to the scrutiny of the X-ray expert before being passed for use. The developments on these lines alone are sufficient to warrant a great increase in the output of electrical and radiographic apparatus.

When the demand for powerful apparatus becomes imperative for trade purposes we may hope to find greater advances in the construction of radiographic outfits for use in the hospitals. The engineering talent employed will devise mechanically accurate devices and mechanisms for moving heavy objects in front of the X-ray tube for screen and plate examinations.

The perfect condition for this type of work, and also for medical purposes, would be to enclose all the active apparatus in a lead-lined room having an aperture to the examination room. The size of this opening could be controlled by a heavily protected diaphragm. Large slabs of metal could readily be passed in front of the aperture for screen examinations, the size of the opening being controlled by the examiner. The examination room would be absolutely dark and ray-proof.

There will be great developments and improvements in mechanism and in tube construction in the near future. The increase in output of the generating plant should enable us to greatly improve radiographic technique. Single impulse apparatus, for instance, should soon be made powerful enough to produce radiographs of any part of the body in from $\frac{1}{100}$th to $\frac{1}{500}$th of a second; then the technique of exposure will be simplified and possibly standardised. The development of radiology in its broadest sense is comparable with that of wireless telegraphy; both are capable of great improvement, and none of us can foretell the far-reaching importance of their future developments and their practical application.

Our American Allies, with their usual foresight, have shown that they are fully alive to the possibilities of the future in this direction. Already they have attained, by organisation and research, a position of preparedness which must command the admiration of those of us on this side of the Atlantic who are competent to judge. That they are fully alive to the future development of radiology in commerce is evidenced by the work done in the radiography of metals and the production of apparatus of a new type to deal with the work.

In the near future every large engineering, munition, and aeroplane factory will have its radiographic department for the investigation of the parts employed in the construction of apparatus. This opens up a very large field for commercialism. It behoves us to prepare seriously for this development if we are not to be dependent upon oversea sources for our supplies of apparatus and tubes. Organisation and research, combined with sympathetic collaboration between manufacturers, physicists, and medical men, should enable us to evolve a scheme which would result in the establishment in this country of facilities for dealing with these developments.

The future of the ARCHIVES is intimately bound up with these future developments. The past three years have been difficult ones in its history. The critical period has, however, long been passed. It will be necessary, however, to energetically carry on our publication on lines worthy of the subjects dealt with. The field must be widened in several directions ; enlargement of our pages must follow when the newer applications of radiography develop. We invite the hearty collaboration of all interested in the work in the hope that in the future, as in the past, our Journal may be a useful one to all who are working on these subjects. It remains with us to see that full advantage is taken of the abundance of new material which will be forthcoming. To take the application of radiography and electrotherapy in the medical service of the Navy and Army alone, it is possible to indicate clearly how the Journal, by giving publicity to the results obtained by workers in these subjects, can help to promote these interests.

A series of papers on the production of electricity, the distribution of the current, and its utilisation for lighting, heating and the energising of electro-medical machines should be of the greatest possible value to all workers. Such a series has been promised by Mr. Duncan Watson, Consulting Electrical Engineer, and a past Chairman of the Marylebone Electrical Supply Committee.

Numerous articles on technique by various writers will appear in due course. Particular attention may be called to the early appearance of a number of papers on Radiographic Technique in the Examination of the Urinary Tract, by Dr. Gilbert Scott, whose unrivalled collection of plates will be placed at the disposal of the ARCHIVES. The practical application of radiography in industry will be illustrated by a paper by M. Pilon on the Radiography of Metals. This, it is hoped, will be the forerunner of a number of articles on similar lines. It is hoped that by widely extending the sphere of usefulness a larger field will be opened up for the circulation of the ARCHIVES. It is anticipated that in this way it may be possible to enlarge the monthly publication, and by the addition of abstracts of wider interest to supply a real demand for information on the part of our readers.

A great deal of useful information has accrued in many quarters as the result of the war. The need for organisation was repeatedly manifest in the general state of unpreparedness at the beginning of the war. Since then much valuable work has been done in many quarters, particularly by the responsible authorities and manufacturers, to meet the unprecedented demand for apparatus. A thorough organisation of radiologists prior to the war would have been an inestimable boon to the authorities in their efforts at the commencement of war. Such an organisation unfortunately did not exist; no scheme of education was available; a unique opportunity was allowed to slip away; but the fault was not wholly attributable to the lack of initiative on the part of radiologists. It has been pointed out by Captain Thurstan Holland, in a Presidential Address to the Röntgen Society, wherein lay the fault, and he ably outlined a scheme for its ultimate betterment and correction.

A number of leading practitioners of radiology and electrotherapy held several meetings to discuss the subject, and the outcome was a scheme for organisation of teaching and post-graduate work throughout the country. This scheme is given in outline in a Presidential Address read by Dr. Harrison Orton before the Electrotherapeutic Section of the Royal Society of Medicine. Subsequent to the address a meeting of radiologists and physiotherapists was held at which important resolutions were passed; these, when materialised, should result in the definite establishment of an active school dealing with these important subjects. The scheme proposed is very comprehensive, and when matured should have far-reaching effects. Nor is this all; other branches of medicine are fully alive to the importance of organisation and preparation for the future. A collaboration between the schools of radiology and physiotherapy, and post-graduate schools in other branches of medicine and science generally, should lead to the establishment of a large central institute in London, with branches throughout the Empire, which by keeping in close touch with the schools of allied countries should go a long way towards the placing of this country in the front rank.

The future of electrotherapeutics is intimately bound up with that of radiology. Prior to the war, owing to various causes, this branch of medicine received little attention from the profession, and the public had to depend largely for treatment upon unqualified men. Almost all the important electromedical devices and methods of applying electrical treatment have been developed during recent years, since the discovery of X rays. The medical men who practised electrotherapeutics before this period, have since then devoted the greater part of their time to the study and development of X rays. The greater attractions offered in the earlier days by radiology weaned these men from the equally important subject of electrotherapy, and for a time the latter subject suffered. One or two men, however, devoted all their attention to the development of new methods of electrotherapy. Of these the undoubted pioneer was the late Lewis Jones, with whose name is intimately associated the successful establishment of electrotherapy upon sound scientific lines as a distinct and valuable branch of medicine.

The onset of the present war has led to the establishment of electrotherapeutic departments in the military hospitals all over the country; and the use of electricity in medicine is being practised more widely than ever before, and its value in the treatment of war injuries and disease has been fully established.

The need for organisation and the training of medical men to act as directors of electrical departments is as urgent in electrotherapy as in the case of radiology. In this branch also it is imperative that steps be taken to establish teaching centres. It is necessary also to make provision for the training of lay assistants to perform routine electrical work and to undertake the care of electrical apparatus, under medical supervision. We fully recognise that for the carrying out of routine work technical and lay assistants are necessary, and that such assistants must possess the necessary skill for the performance of such routine work. In both these instances this form of assistance should receive due recognition and adequate remuneration, in order that persons so trained may not be tempted to abuse their position by undertaking that part of the work which should never be done except under medical supervision.

The important steps in the development of radiology and electrotherapy have been rendered possible by the work of eminent physicists. This has not been sufficiently recognised, and the physicist has been to some extent overlooked. This cannot continue if further progress is to be maintained. The physicist will probably occupy a prominent place in all such schemes for future development, and should receive adequate recognition and remuneration.

Any scheme for the organisation and teaching must include in its *personnel* a number of physicists who are specially qualified to teach in these subjects. Consequently, no association or teaching staff can become exclusively medical.

TWO CASES OF RARE DEFORMITY OF FEET AND HANDS.

By C. Thurstan Holland, M.R.C.S., etc. Captain R.A.M.C. (T.F.).

An experience of over twenty-one years of radiography justifies the title of this short communication, and the publication of the radiographs of the two cases on which it is based. Coincidences always strike with a certain degree of force, and create some impression on the mind. It is a matter of common knowledge that one goes for months, or even years, without X-raying a certain condition, and then in a short space of time it will turn up on several occasions. For many years I have been on the lookout for abnormalities of development of the hand or foot, with special reference to the carpus and tarsus, and have practically met with none. Then, within the space of one month, I met with two of the rarest varieties of congenital abnormality of these regions one can meet with.

I must confess not to have made a complete search of the literature; in these times it is not an easy matter to be punctilious in this respect, but in a somewhat casual search I have not come across any description of radiographic appearance such as the following cases present.

The latest Quain says, "Tarsal bones may be fused with their neighbours; thus the talus may be united to the calcaneus; the talus to the navicular; the calcaneus to the navicular; the navicular to the cuboid; the calcaneus to the cuboid; the second to the third cuneiform. The metatarsals 2 and 3 may be united with their respective cuneiform bones. The normal number of carpal bones may be reduced by the fusion of elements, *e.g.*, the lunate and triquetral bones are occasionally seen coalesced."

Douglas E. Derry (*Jour. of Anat. and Phys.*, Oct., 1906, p. 56), describes two cases of "Fusion of the Semilunar and Cuneiform Bones in Negroes."

Adam A. McConnell (*Jour. of Anat. and Phys.*, July, 1917, p. 302), thinks this condition is more common in negroes than whites, and mentions a similar condition in a white man.

Dwight, one of the greatest authorities on the subject, in his well-known monograph on "Abnormalities of the Hand and Foot," which is illustrated by many photographs and radiographs, shows photographs of two cases of fusion of semilunar and cuneiform bones in the carpus of a negress and of a white male; and also reproduces a photograph of fusion of the external cuneiform and third metatarsal bone, with all the other foot bones normal. Those are his only two cases bearing on the subject. Possibly there may be other published cases, but nevertheless, such cases are so rare that a description of the two I have recently met with is fully justified.

Case I.—Male, aged 33 years, was sent to me complaining of obscure pain in his right foot. He stated that all his life he had been unable to bear the slightest human touch on the dorsum of the foot. If touched by a human being on this area it turned him sick and he felt faint. On the dorsum was a healed scar, said to be due to an operation when a child; it was not adherent to underlying tissues, and quite healthy in appearance.

He had no obvious deformity of the foot, with the exception that it was smaller than the other, being exactly ½ in. shorter. There was no flat foot on either side. He walked normally. All the movements of the foot seemed to be normal.

A radiograph showed the condition seen in Fig. 1. (this is not taken straight through from side to side, but the foot is tilted to give a better view of the anterior tarsus and metatarsus).

The points are:—

1. The cuboid is completely fused with the base of the fourth metatarsal; no line of demarcation can be seen, and the shape of the joint formed by the base of the fifth metatarsal is more oblique than is normal.
2. The external cuneiform is completely fused to the base of the third metatarsal.
3. There is only an indication of a joint between the middle cuneiform and the base of the second metatarsal.
4. The scaphoid (navicular) is completely fused with the internal cuneiform.
5. The joint between the internal cuneiform and the base of the first metatarsal is poorly formed.

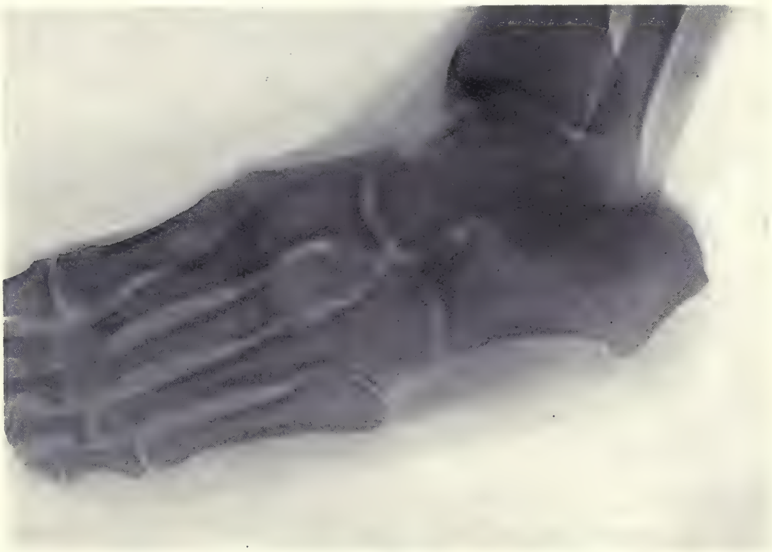

Fig. 1.

Radiographs of the other foot showed all the bones to be perfectly normal. There was no suspicion of anything wrong with the hands and wrists, and these were not radiographed.

The second case is even more extraordinary and unusual.

A young woman, aged 21 years, was sent to me by Dr. Knox and Mr. McMurray on account of pain and swelling over the second toe on the right foot of four weeks' duration, with a query as to its being tuberculous. She stated that some years previously she had had a similar attack. Fig. 2 is a reproduction of the radiograph taken.

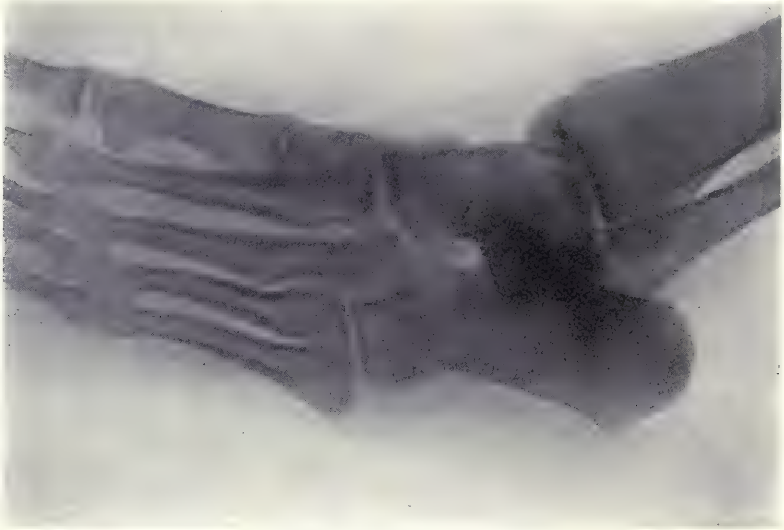

Fig. 2.—Right Foot.

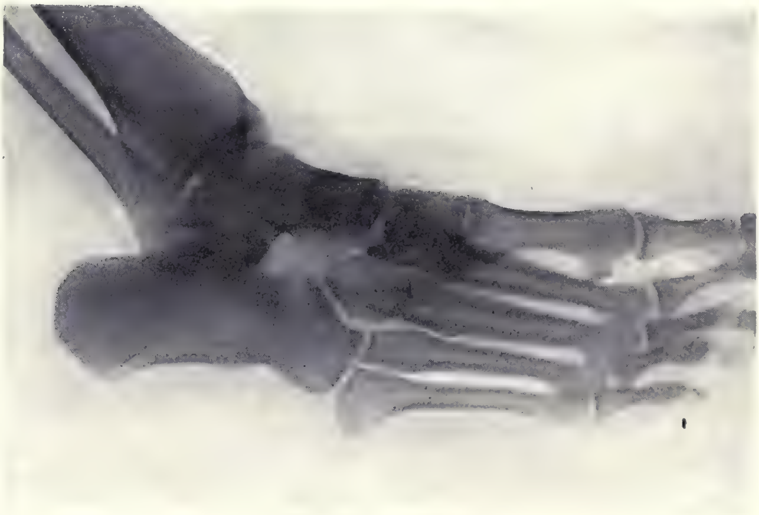

Fig. 3.—Left Foot.

1. The os calcis and cuboid are completely fused, without any indication of the junction.
2. The external cuneiform is fused, partially, with the base of the third metatarsal, but a line of demarcation is shown.
3. The middle cuneiform is completely fused with the base of the second metatarsal.

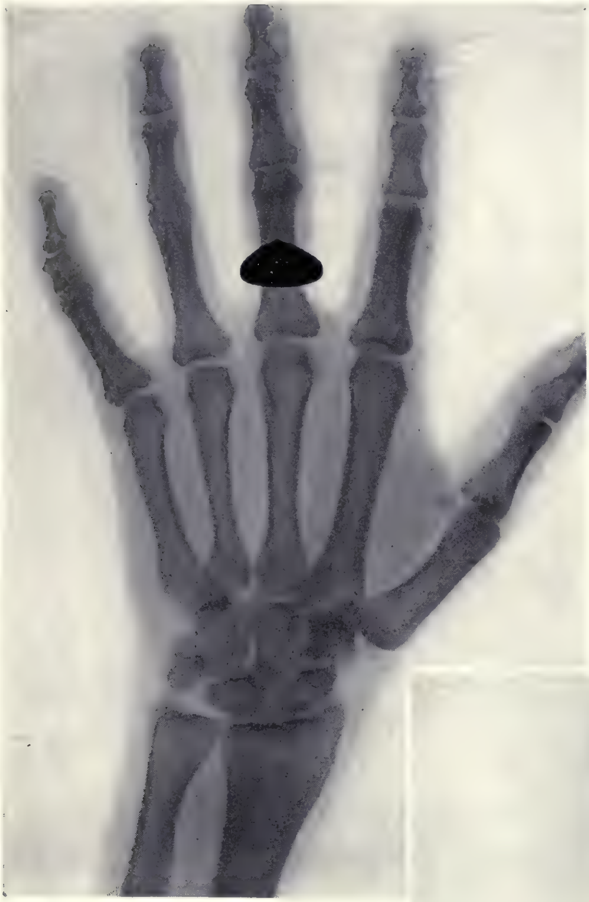

Fig. 4.—Right Hand.

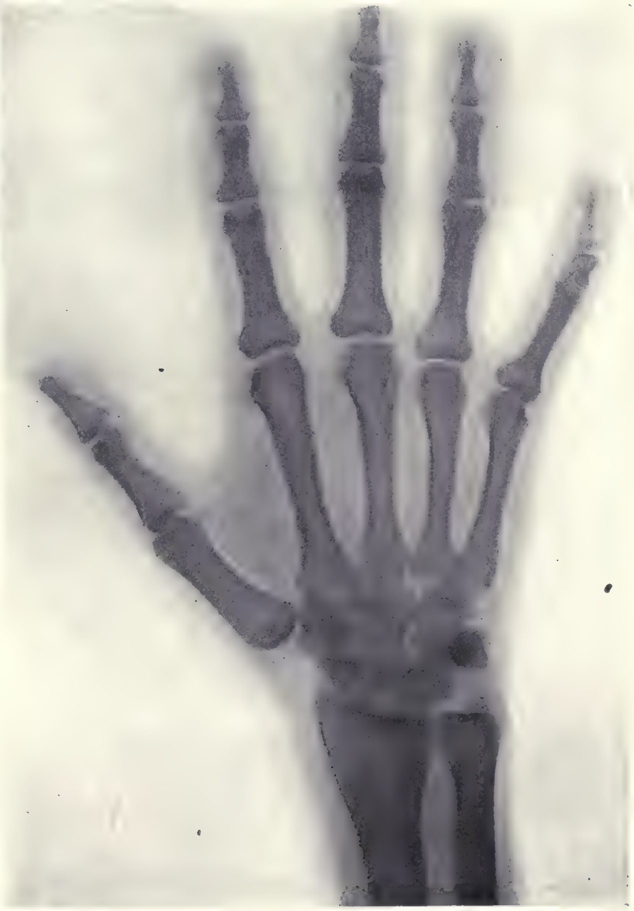

Fig. 5.—Left Hand.

PLATE 11.—Illustrating a case of Rare Deformity of the Hands and Feet. By C. THURSTAN HOLLAND, M.R.C.S., etc., Captain R.A.M.C. (T.F.)

4. The astragalus is completely fused with the scaphoid, but shows in the upper part an indication of demarcation.

The joint between the internal cuneiform and the base of the first metatarsal is well formed and normal.

Nothing was noted at the time as being wrong with the other foot, but when this condition of the bones of the right foot was found she was asked to come again for further investigation.

A visual examination of the feet showed nothing abnormal, both appeared to be perfectly formed, there was no obvious deformity, no flat foot, and both were the same shape, etc. Radiographs of both feet in various positions were taken, and both were found to show exactly the same condition of the bones. No pain had ever been complained of in the left foot.

Fig. 3 shows that the left foot is deformed in exactly the same manner as the right.

Attention was then given to the hands, and though both looked normal—except for the shortening of the little fingers—the wrists were found to be somewhat stiff, and the patient said that she found that, owing to their stiffness, she could not play the piano.

Additionally, one finger joint—the proximal interphalangeal joint of the right ring finger—was somewhat swollen and somewhat stiff.

The hands are reproduced—Figs. 4 and 5—viewed stereoscopically (stereoscopic radiographs were taken), each exhibited the same peculiarities.

1. Fusion of the cuneiform and unciform bones.
2. Fusion of the os magnum and trapezoid bones (complete on the left side, incomplete on the right side.)
3. The semilunar, instead of being so directly under the os magnum, as is usual, on each side is between the os magnum and unciform, and articulates equally with each.
4. The scaphoid is abnormally shaped in each hand.
5. Each little finger shows a short middle phalanx.

Apart from the rareness of these deformities the interesting point as regards the feet is that they could be present without any visual alteration in shape, with the exception that in the case of the man the affected foot was smaller than the other. The pain in either case did not seem to be connected with the deformity.

The advantage of stereoscopic radiography in showing the exact condition of the carpal bones is well demonstrated by viewing in this manner the original stereoscopic plates. Not only do these demonstrate clearly the exact bone condition, but they show most beautifully the variations in articulation produced by the deformities.

The reproductions illustrating this article indicate the conditions described, but the correct interpretation was only arrived at by a study in the case of the carpus of the stereoscopic negatives, and in the feet by a study of various negatives taken in different positions.

A STUDY OF THE INTER-RELATION BETWEEN THE RADIOGRAPHY AND SURGERY OF GUNSHOT WOUNDS OF THE HEAD.

By Captain H. E. Gamlen, R.A.M.C. and Captain S. Smith, R.A.M.C.

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At this General Hospital we have a record of at least 1,500 radiographs of gunshot wounds of the head taken during the past eighteen months, a large proportion of them involving the skull and underlying brain. Thus we can lay claim to a considerable experience in the taking and interpretation of such radiographs.

Apart from the clinical picture, the factors which influence us when the question of operative interference comes to be discussed are : (1) The local condition of the wound ; (2) The X-ray appearance. In deciding upon the value of the second factor, it is important that the surgeon and the radiographer should work in harmony, each surgeon examining the radiographs of his own cases and discussing them with the radiographer ; for no surgeon without considerable experience in this work can interpret his own plates without help from the expert. A dried articulated skull is of great assistance in forming a good mental picture of the anatomy of the lesion ; and just prior to the operation the radiographs should again be inspected, so as to revive the picture clearly in the memory of the operator.

We have divided our paper broadly into three sections :—

1. *The Method employed in taking the Radiograph*, discussing fully our technique where it has seemed to differ from that in common use.
2. *The Interpretation of the Radiograph.*
3. *A Classification of the Type of Injuries Revealed by the Radiographs*, and a discussion of the surgical practice adopted for each type.

1. *Method of Taking the Radiographs.*

We would at the outset insist that stereoscopic views should be taken in every case, being firmly convinced of the paramount importance of this method, which enables one as it were to look right into the patient's head, and to view in relief the injury to the various strata as it really exists.*

In radiographing these cases of head injury as we get them, comparatively soon after the infliction of the wound, special difficulties present themselves. The patients are often in a peculiar mental state, maybe restless or delirious. Consequently it may be necessary in certain of the cases to give an anæsthetic to ensure a reliable result. Short of this, rapid work with intensifying screens, necessitating an exposure of only a few seconds, may overcome the difficulty. The majority of slightly restless patients can be kept still, however, for the ordinary exposure of twenty seconds, with a compression cylinder, by making use of a paper air-cushion wedged between the head and the compressor.

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* The illustrations in this article are printed each from a single plate of a stereoscopic pair, and consequently fail to show the depth of strata which is essential for the surgeon.

The size of the plate, position taken, condition of the tube, number of milliampère-seconds given, and distance of the plate from the anode, are tabulated. Careful notes are also made on the final treatment of the plate, whether it is normally, under-, or over-exposed, and whether correctly, under-, or over-developed. Finally, the radiographer's diagnosis is added. These reports are standards for future work. Reduced stereoscopic slides are sometimes made, which often give a clearer and more instructive view with the hand stereoscope than the original negatives, because in reproduction any fault in density may be overcome.

Technique Employed.—As a preliminary, a small lead wire ring is placed over the wound surface, a clean new ring being used for each case.

At the outset it is necessary to decide in what position it is best for the head to be fixed for any given wound. In addition, the relation of a retained missile to the wound of entry, and the probable direction of any brain track, should be known. If time allows, therefore, a preliminary screening should be done, in order to give some idea of the position of the missile, which can generally be quite easily seen. Only in exceptional cases can one by screening follow the line of fractures, although if there be a large bone defect it can often be seen, as can also the track made by a large foreign body.

The wound surface should always be that nearest to the plate, with the area immediately surrounding the wound actually in contact with it, since in viewing the stereoscopic radiographs afterwards, the best results are obtained by viewing through the healthy on to the injured side.

If the wound and the position of the missile as viewed through the screen lead one to believe there is a track running in any given direction, experience has shown that the most satisfactory results are obtained by radiographing this track at an angle.

It is evident that the knowledge gained by screening, of the best possible route, and of the line of least resistance to the rays in various parts of the skull, greatly facilitates the work. Thus, in taking lateral views, we always endeavour to centre our rays through the squamous temporal, as offering less resistance than the thicker regions of the skull.

The condition of the tube, and the exposure, have often to be altered to suit the particular view which is to be taken. A lateral view, for instance, requires different conditions from an anteroposterior view in order to obtain the best results.

Of necessity the supine position is that selected for the majority of our cases, as few of them are sufficiently recovered on arrival to allow of any other position. If he has a short neck, the patient may find some of the postures uncomfortable, but this difficulty can usually be overcome by allowing him to rest on his side with the plate-holder raised to a higher level than that usually employed, using wooden wedges where necessary.

When correctly adjusted, the head is fixed by means of paper air-cushions, partly inflated, which are placed between the head and the compressor. These take a grip of the greater portion of the head facing the tube, and an extra push downwards of the compressor makes any movement impossible. The radiographs are usually taken with the head in the lateral position, centring just above the external auditory meatus. If, however, the injury is near the vertex (this embraces the very important class of sinus injuries described by Sargent and Holmes), the head is tilted so as to allow the vertex to be nearer the plate than the base; and *vice versa*, if there be an injury in the neighbourhood of Reid's base line, the base is approximated to the plate.

Slight manipulation of the skull in its relation to the plate, with a view to bringing the injured area as near the central rays as possible, brings out many details not otherwise obtained. In certain special cases, the indications for which will be described later, radiographs of the cranium are taken in an anteroposterior direction, the face being placed on the plate and the rays passing directly through the skull from behind forwards; central rays are then made to hit the back of the skull one and a half inches either above or below the inion.

The distance of the anode of the tube from the plate varies from 58 to 64 cm., and the diaphragm is cut down so that both radiographs (stereoscopic) are just contained in the circle of illumination. The tube shift is 6 cm. The length of exposure varies with the age of the individual, old people requiring a longer one than young. The breadth of the head has to be taken into account, but as a general rule 120 to 140 milliampère-seconds are sufficient for lateral views, with an addition of about 30 per cent. for anteroposterior positions of the skull. Until recently we have always had a vacuum tube in circuit; but lately we have replaced this by a mechanical rectifier, which successfully prevents any of the inverse current from entering into the X-ray tube. The best work is done with the tube in a condition of 6 to 7 Bauer, the development being carried on from 15 to 18 minutes. Plates thus taken will show the contour of the skull on both sides when viewed stereoscopically. The majority of the lines of shadows are cast by the side of the head which is nearer the plate, and can be increased or decreased at will by varying the distance of the tube from the skull. These shadows can still further be modified during the development of the radiographs.

Positions of the Head.—As a result of our experience and of many trials, we now always fix the patient's head in one of the seven positions about to be described. The position varies according to the situation of the wound. From our records we find that the majority of wounds of the cranium occur over the temporoparietal area (50 per cent.), next in order come those over the frontal area (25 per cent.), and finally those over the occipital area.

A. *Lateral Views.*

Position 1.—Particularly adapted for showing injuries to the lateral aspect of the frontal bone, the temporal bone, and also the parietal bone except at the summit. Lateral view centred at the temporomaxillary joint at the level of Reid's base line.

On looking from the healthy to the wounded side, a good view of the whole of the lateral aspect of the frontal and parietal bones is obtained, except towards the summit, and the squamous temporal is also well seen. We can trace the edges forming the boundaries of the lateral sinus from the torcular forward as far as about the middle of the petrous bone, where the sinus sinks below the dense shadow cast by this bone—though towards the anterior part the edges become indistinct owing to their overlapping. The whole of the grooving for the superior longitudinal sinus can be made out, most distinctly in the anterior frontal and posterior occipital regions. Lateral views of the orbital plates of the frontal bones are seen, and the pituitary fossa and clinoid processes are very distinct. If, as sometimes happens, the sphenoidal cells are large and occupy a great part of the body of the sphenoid, they show up well. In this position the two temporomaxillary joints overlap, and consequently an indistinct view of these is seen. Overlapping views of the rami of the inferior maxilla are also obtained.

Position 2.—Adapted for showing the posterior parietal, temporal, and occipital regions. Lateral view centred at the base of the mastoid.

A better view of the orbital plates of the frontal bone is obtained than in *Position* 1, since the overlapping is not so marked. The pituitary fossa and clinoid processes are still well seen. A good view is obtained of the petrous bone throughout the greater part of its length. The anterior part of the lateral sinus is also seen better than in *Position* 1. In looking through the uninjured to the injured side, we see less of the contour of the temporal, parietal, and occipital bones than in *Position* 1. A very good overlapping view is also obtained of the inferior maxilla, provided the mouth is open.

By centring at a slightly higher level, say the level of the upper attachment of the pinna, we obtain a view looking into the cavity of the cranium from above. By centring thus, a better view is obtained of the orbital plates and of that part of the squamous temporal above and in front of the apex of the petrous bone. The bony landmarks around the foramen magnum are well brought out by this view.

Position 3.—Specially adapted to show injury to, or in the neighbourhood of, the superior longitudinal sinus. If an injury is seen at or near the vertex, the head is tilted so as to allow the vertex to be nearer the plate than the base. This is done by placing an air-bag under the shoulder and neck, so that the mastoid is 1 to $1\frac{1}{2}$ inches above the plate, and the central line of the vertex considerably nearer it than occurs when the two methods previously described are adopted. The base line is centred as appears most convenient, depending on the position of the wound.

When looked at from the uninjured to the injured side, we obtain an excellent view of the whole of the inner aspects of the frontal and parietal bones, together with the greater part of the occipital bone. The bones which go to form the bed of the superior longitudinal sinus are also well seen, the position now described being especially adapted for fractures in this neighbourhood. Previously, when lateral views were the only ones taken, thus allowing the opposite parts of the skull to overlap, one often experienced great difficulty in reading the radiographs, especially when the bony injury crossed or was in the neighbourhood of the several sinuses ; slight fractures with depression of the inner table have been mistaken for lacunæ, the markings of blood vessels, or overlapping of ridges which go to form the sinus. It was soon found that these defects could be overcome by tilting the head in various ways so as to prevent the overlapping of the opposite shadows, and now we experience no difficulty in revealing fractures over the superior longitudinal and lateral sinuses.

A good view of the posterior surface of the petrous bone is obtained on the injured side, and also of the under surface of the base of the skull.

On reversing the plates, we have a still better view of the bones forming the upper half of the cranium, but not so extensive a view of the base as seen from above. A good anterior view of one petrous bone, and both aspects of the other, are shown. The torcular and the occipital sinus are well seen. In the event of the radiograph being taken with the mouth open, we obtain a good view of the temporomaxillary joints, and both sides of the inferior maxilla are very clear except in the central line, where the shadows overlap at the chin.

Position 4.—Specially adapted to show injuries at the base of the skull, the posterior mastoid, the occipital bone, and the lateral sinus. Great care has to be taken with this position in order to obtain the results desired. The head is first placed flat on the plate-holder, and an air-cushion introduced under the vertex and so arranged that the front of the head is at a higher level than the back. The plate is pushed so that its lower end rests under the third or fourth cervical vertebra, with the mastoid process resting firmly on the plate. By centring exactly two inches above the external auditory meatus, the central rays will pass in just posterior to the petrous bone ; 10 per cent. increase of exposure over the normal is allowed for this view.

On looking through the healthy on to the injured side of the skull, we obtain a good view of the orbital plates and the lateral aspect of the frontal bone, and of most of the parietal bone. Provided the angle is correct, a perfect view of the temporal and occipital bones is given.

If we centre a little higher, the lateral sinus throughout most of its extent, and the region of the foramen magnum, with the first and second cervical vertebræ, are added to the above view.

On reversing the plates, the base of the skull as seen from the underside is very distinct. With the mouth open, a good view of the inferior maxilla and of both temporomaxillary joints is obtained. This is the most suitable view for dental surgery, as there is no overlapping of the structures of the mouth.

B. *Anteroposterior Views.*

Anteroposterior views of the head and neck are particularly useful for localizing the position of foreign bodies in relation to the central line.

Difficulties have been experienced in the past in giving the exact position of a missile lying in or near the body of the sphenoid, the anterior portion of the foramen magnum, or the bodies of the first to the third cervical vertebræ. The results obtained by operations undertaken for the removal of missiles lying in any of these localities vary very greatly according to the exact position of the missile and the relative ease with which it can be approached and removed by the surgeon. Consequently great attention to detail is essential. In the first place, if the correct exposure for a lateral view is known, an addition of from 25 to 30 per cent., using a tube low in vacuum, will give the best results. The head also must be securely fixed and centred. If good lateral views have already been taken, there is no necessity to screen; otherwise one always screens, with the tube below the couch, using a high milliampèrage and a diaphragm cut down to give a minimum opening.

Two particular difficulties that have to be overcome in these anteroposterior views are:—

1. The broad horizontal band of shadow cast by the petrous bone. It is essential that, by tilting the head in a vertical plane, this shadow be prevented from overlapping that cast by the missile, or the value of the resultant picture will be much diminished.

2. The shadow cast by the lower jaw. This difficulty can usually be overcome by opening the patient's mouth to its widest extent, and fixing it in this position by a piece of cork placed between the teeth.

Position 5.—The plate rests on the forehead, and lightly touches the nose, the chin being two inches above the plate.

In this view the shadows cast by the petrous bone pass across the level of the upper part of the orbit, and it is only structures or foreign bodies within the skull above the upper limit of this shadow that are distinctly seen. We obtain a fairly clear view of structures lying immediately beneath the skull, particularly the first to the third cervical vertebræ, the pharynx, maxillary antrum, etc. Foreign bodies in the face below the level of the orbit can also be well seen.

Position 6.—The plate rests on the chin and the tip of the nose, and the central rays strike the back of the cranium at a slightly higher level.

The dark shadow cast by the petrous bone now obliterates the lower part of the antrum, but leaves a full view of the forehead, orbits, and upper part of the antrum. The greater part of the temporal and sphenoidal bones are well seen. With the mouth widely opened, a good view is obtained of the anterior aspect of the occipital bone, the foramen magnum, and the first three cervical vertebræ.

Position 7.—The plate again rests on the chin, but is separated an inch from the tip of the nose. This position is obtained by means of an air-cushion, resting on the forehead, between it and the plate. The central rays pass through the back of the cranium at the inion or just above it. It is necessary to further increase the amount of exposure to obtain the best results.

In this view the shadow cast by the petrous bone has moved still further down the face, and now lies at the level of the teeth when the mouth is closed. Within the cranium there is an unobstructed view of the interior. Below the level of the skull a further view of the region around the foramen magnum is obtained. The frontal and sphenoidal sinuses and the ethmoidal cells are particularly well shown. A good view of the whole of the antrum, nose, and orbits is obtained.

II. *Interpretation of Radiographs.*

All those who have written on gunshot wounds of the head in the present war seem to be unanimous as to the paramount importance of a good X-ray photograph being taken as a preliminary to any operative interference, unless there be specially urgent reasons for performing an emergency operation.

In many cases which have come down the line after having been already operated on in front-line units, a radiograph taken at this base hospital has shown flakes of bone and shell fragments still remaining embedded in the brain, in quite accessible positions. Secondary operations have often been necessary, the trephine opening, often a small one, has had to be enlarged, and the fragments, commonly the centre of a foul-smelling abscess, have had to be removed. One need hardly say that the mortality is high where such secondary operations have been necessary. We conclude from our experience of many of these cases, that if a radiograph was taken at all at the front, it must have been only a flat negative. One cannot insist too strongly on the necessity of stereoscopic pictures being taken in every instance, and with the greatest possible amount of detail. In viewing these plates through the stereoscope, it is important to have some method by which the light can be regulated, either generally, or locally in part of the field, for often a fracture invisible with a bright light is brought into view with a dimmer illumination.

In certain cases the lobulations of the brain itself can be distinctly seen. Particular attention is drawn to the fact that when a layer of blood-clot lies over the cortex, such an area of injury is seen less distinctly than is the surrounding brain, which fact has proved of some diagnostic value.

Foreign Bodies.

Method of Localization.—By the use of a pair of compasses and a scale, one can in a few seconds give the size and depth of a foreign body below the wound surface once good stereoscopic negatives have been obtained, thus doing away with much of the elaborate machinery which has come into such prominence during the present war. On each plate appears the shadow of a pair of cross-wires at right angles to one another and in close proximity to the plate. The tube is moved a known distance between the two exposures in a direction parallel to one of the cross-wires. This causes the shadow of any foreign body to shift along the line. By the use of a pair of compasses one measures the distance of the foreign body from the other wire in each case. The difference between the two measurements gives us the shift of the shadow. There is a simple geometric relation between the shift of the tube, the shift of the shadow, and the distance between the anticathode and the plate. The shadow shift having been measured, it requires only a moment's calculation by the use of a slide-rule to determine the depth of the missile.

In reading such radiographs stereoscopically, one has to make allowances when, say, a dense white object, such as a bullet or shell fragment, is viewed against other objects the groundwork of which is not of so dense a composition, such as bone or soft tissues. The denser object will always appear nearer the observer than it really is. But as this occurs again when the plates are transposed, the fallacy is repeated, and the error can easily be corrected by experience, as there are so many other detailed parts in the field which can be brought into alignment.

Alterations in Position.—Some radiograms show that the missile has travelled in a zigzag direction before becoming stationary; in one case we were able to show clearly three distinct tracks due to the missile having twice been deflected at an angle. But apart from the clear proof that missiles are occasionally deflected in their flight within the skull, there is another possibility that has been discussed by surgeons—namely, as to whether a retained foreign body may suffer secondary displacement as the result of falling downwards under gravity. From the evidence gained by frequently re-radiographing heads with retained missiles, we have come to the conclusion that there is rarely a late movement of the missile through the brain. In one case, however, at the first examination a damaged area was found extending beyond the foreign body, and a later radiogram showed that the missile had now travelled a short distance beyond its original situation, having indeed dropped forward into the area of ploughed-up and softened brain that already lay in front of it. But this type of movement is quite a different matter from that of a missile travelling later by its own weight through healthy brain. We have had the opportunity of viewing several radiographs which were supposed to demonstrate free movement beyond the track of a missile, but we have failed to convince ourselves of this movement, as in all cases examined, the second radiograph was taken in a different position from the first. Unless there is exact reduplication of the position of the head in the radiographs, the altered position of the missile is difficult to prove.

Distinguishing Characteristics.—It is sometimes difficult to distinguish between pieces of shell and of lead, and also between these missiles and bone fragments turned on edge. Rifle bullets end on to the plate may be mistaken for shrapnel balls. The distinction between lead and shell-casing is important when the question of the use of the magnet for extraction purposes is considered, as the magnet has attraction for pieces of shell-casing and rifle bullets, but none for lead. Pieces of lead are generally distinguished from shell-casing by their difference in shape and whiter appearance. When pieces of lead penetrate the cranium, they nearly always shed fragments in the brain track, and these are easily recognized by their white glistening appearance against the darker background (Fig. 7).

Pineal Body.—The shadow cast by the pineal body may easily be mistaken for a bone fragment. On several occasions while examining radiographs for lesions, we were puzzled by the presence of a small circumscribed area of density, generally oval in shape, and closely resembling a small flake of bone. Its position was constant, being situated midway along a line drawn between two points above and behind the two external auditory meati. To decide the nature of this small body, lead cyphers were fixed to the scalp two inches above the nasion and one inch above the inion. The object lay just above the line joining these two points, and about midway along it. Nasion to inion equals 20 cm.; the body was found 11 cm. from the nasion. This is the actual position of the pineal body in the middle line of the skull (from its position Lieutenant-Colonel Gordon Holmes assumed it to be the pineal body). In certain cases where a fracture exists, the presence of this small organ has complicated the diagnosis. We have already collected ten radiographs showing the presence of the pineal body, its visibility being doubtless due to the accumulation of opaque concretions that are liable to form in this organ after adolescence (Fig. 1).

Diagnosis of Fractures.—The dark shadow cast by a wound of the scalp, especially when there is considerable loss of tissue, is sometimes mistaken for a fracture; and the lighter markings due to the obstruction caused to the rays by some dressings, especially cyanide gauze, have to be kept in mind.

Sutures.—A fracture in the situation of the sutures may be overlooked, especially if it is small, and running in the same direction. In these instances radiographs should be taken so that there is no overlapping of the corresponding sutures on the two lateral aspects of the skull, and they should give the fullest possible detail.

Doubtful markings in the position of the Wormian bones present difficulties.

Fractures in the line of the sagittal suture cannot be always diagnosed if an ordinary lateral view is taken. The shadows of the ridges which go to form the bed of the superior longitudinal sinus overlap, and it is only by taking radiographs in *Position* 3 that they can be separated so as to bring clearly into view the line of the suture.

The lambdoid suture along its whole length requires the minutest inspection to eliminate the possibility of fracture. In the position of the posterior superior and the posterior inferior parietal angles it presents difficulties which sometimes can be only overcome by radiographing in *Position* 4.

Minute fractures in the neighbourhood of the lateral sinus, especially beneath the petrous bone, are liable to be overlooked. Fractures in the position of the torcular are easily diagnosed, provided they are taken in *Position* 4 or 5.

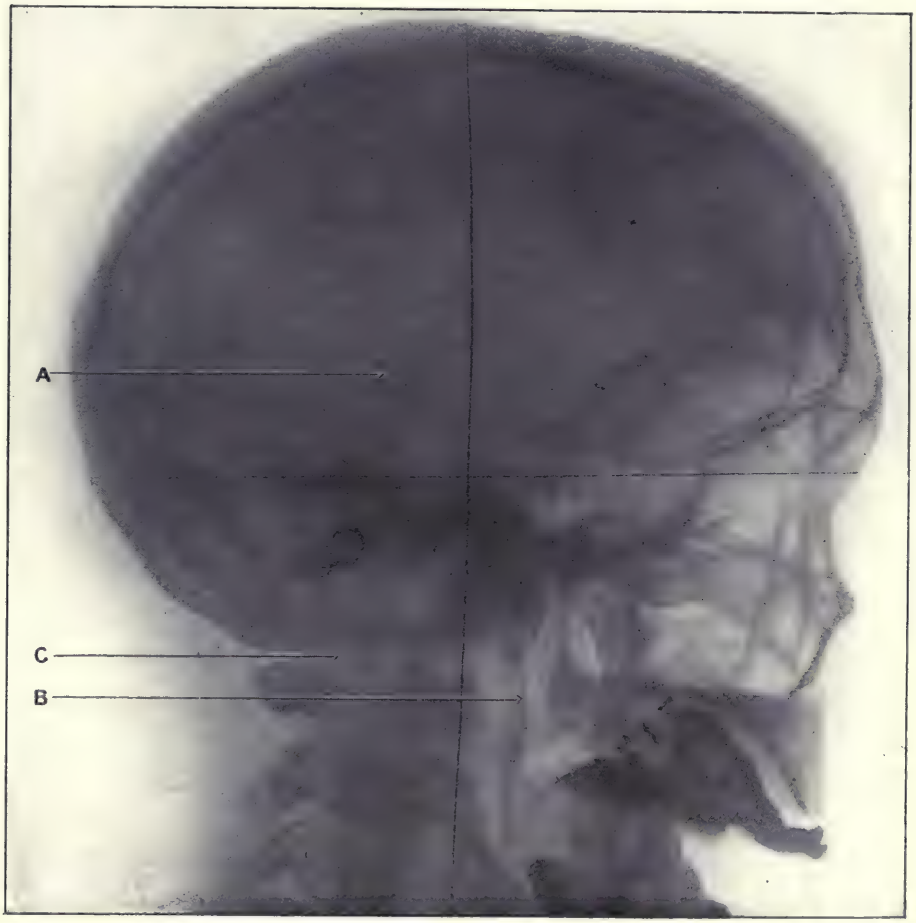

Fig. 1.—*Position* 4. Ring on scalp wound; no fracture, and no cranial injury. **A.** Pineal body, well-marked, opaque, and resembling a foreign body; **B.** Styloid process and stylohyoid ligament well-marked; **C.** One condyloid process of occipital is fairly seen.

It is necessary to draw particular attention to a triangular shadow cast by the tip of the lesser wing of the sphenoid passing upwards and backwards, slightly in front of and parallel to the groove formed in the bone by the middle meningeal artery, as it is often overlapped by the one cast by the middle meningeal artery where it grooves the anterior and inferior parietal. We sometimes have found difficulty in giving a definite diagnosis in this situation.

Blood Vessels.—In a large number of radiographs the shadows cast by the diploic, meningeal, and other blood vessels of the brain are clearly shown, and in some cases difficulties have been found in distinguishing them from fractures. We have to take into consideration their length, shape, branchings, their thinning as they travel upwards to the vertex, and their presence on the opposite side of the cranium when the plates are viewed reversed.

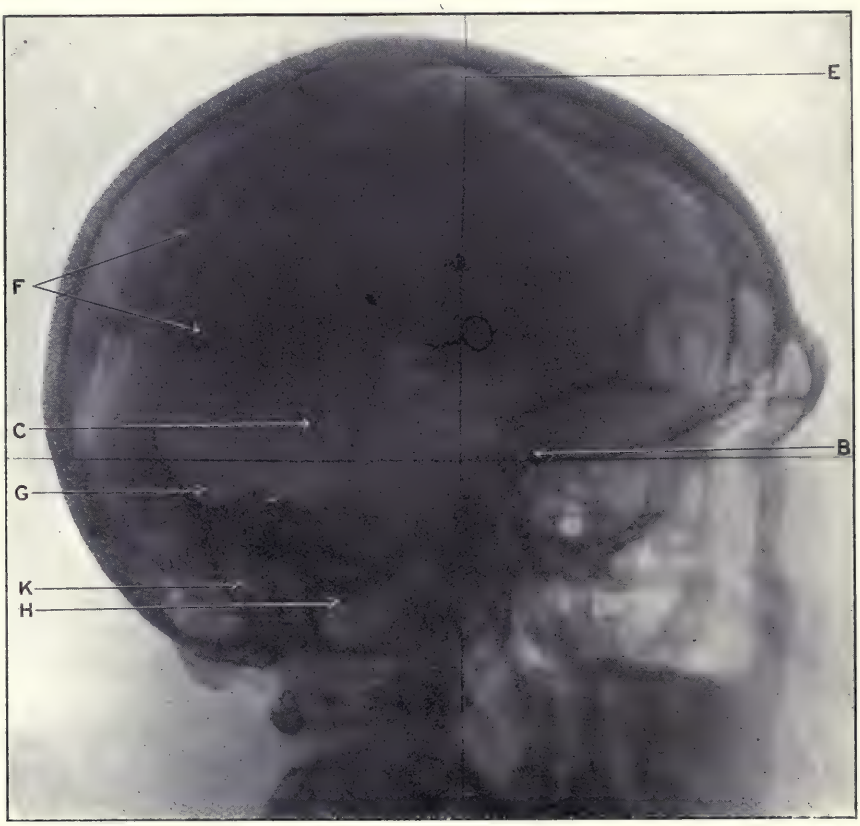

Fig. 2.—*Position* 4. Showing the posterior vascular sinuses. Depressed fracture; no penetration of dura. Ring marks the scalp wound, from the posterior extremity of which runs downwards and forward a wavy depressed fracture as far as the anterior missile B. It then passes downward and backward, where it terminates at the lambdoid suture C. Missiles are embedded in the bones. E. Well-marked lacunæ; F. Longitudinal sinus, which is seen passing backward and downward to the torcular G, and then outward and finally inward beneath the petrous bone to its termination H. The occipital sinus lies between G and H; H. Foramen magnum.

Lacunæ due to thinning of the cranium by Pacchionian bodies sometimes require the minutest attention, especially when there are scalp wounds in the neighbourhood (Fig. 2).

Experience has shown that with well-prepared plates, carefully examined, it *is very rarely that a fracture, however minute, is missed.* The following case well exemplifies this point :—

Case 1.—Pte. M. was brought into hospital on Aug. 24th, 1916, suffering from a wound of the vertex received the day previously. He exhibited slight sinus symptoms. Examination revealed a dirty gutter-wound stretching across the vertex, 9½ inches behind the nasion (nasion to inion 13½ inches), with bare bone showing. X rays showed a minute defect exactly over the sagittal suture, with a large flake of in-driven table under it. Two small metallic fragments were seen lying in the right cerebral hemisphere at a considerable distance from the wound of entry.

Operation was performed on August 25th. A flap was turned down, including the wound and a large area surrounding it. No sign of any fracture of the outer table was seen, and the sagittal suture appeared normal. It was thought inadvisable to trephine on account of the dirty nature of the scalp wound, and there seemed to be more than a suspicion that the X rays for once had lied. Two days later the patient's temperature suddenly rose to 103°. He became unconscious, the sinus symptoms in his legs progressed, and his left arm, which had previously been normal, became paralyzed. The flap was re-opened; now, over an area the size of a five-shilling piece, surrounding that portion of the sagittal suture where the X rays had revealed a deficiency, there was a discoloured patch of outer table. Even then close examination revealed no fracture. A trephine disc was removed just to the right of the unhealthy area, and this latter was removed with forceps as far as possible in one piece. A large flake of inner table was found depressed on to the dura, and there was a small dural defect immediately to the right of the sinus, which bled freely during the course of the operation. A deep brain-track led downwards and to the right in the direction of the shell fragments. Examination of the bone removed suggested that the missile may have entered as one piece and subsequently broken up into two, passing between the lips of the sagittal suture, for no fracture could be discovered.

(To be Continued.)

REPORT OF SOCIETY.

REPORT ON THE RADIUM TREATMENT AT THE ROYAL INFIRMARY, EDINBURGH, DURING THE YEAR 1916.

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Sixty-six patients attended for radium treatment during the past year, whereas 64 attended during the previous year. The total attendances during the year were 520. Of the 66 patients, half were in-patients from other departments of the Infirmary. Twenty-eight suffered from rodent ulcers, 25 from inoperable malignant disease, 7 of these affecting the vagina or cervix uteri. There were 7 cases of exophthalmic goitre and 4 of nævi. Amongst the malignant cases there were 8 sarcomas and 17 carcinomas. The former are more amenable to radium than the latter, and sometimes disappear in a remarkably short time. They are, in the writer's experience, invariably benefited by radium treatment, and if accessible and localised, can be entirely removed. Rapidity of growth is no contra-indication to the use of radium, for rapidly proliferating cells are very vulnerable to its radiation; there is in fact reason for believing that they are more vulnerable than cells which in morphology and growth more nearly resemble the normal. This has been brought to the writer's notice on certain occasions. This leads to the important question, "Are all sarcomas equally amenable to radium treatment?" If a negative answer must be given to this, then what conditions determine a tumour's sensitiveness? Gaarenstroom, of the Amsterdam Cancer Institute (*Archives of Radiology*, December, 1916), is of opinion that the histological structure is the chief criterion, and that round-celled sarcomas generally react favourably, spindle-celled less so, and polymorphous-celled least so. He bases this opinion upon an experience of 23 cases treated by the Roentgen rays. He made no use of radium, and the effect of radium rays is not quite the same as the effect of Roentgen rays, the former having much more penetrative power. At any rate, the writer has frequently had rodent ulcers sent to him for radium treatment, which have been treated unavailingly by Roentgen rays, and these rodents radium has cured. This may have been partly due to a more appropriate dosage and closer apposition. Myelosarcomas, lymphosarcomas, large spindle-celled sarcomas, and parotid mixed celled tumours are extremely sensitive, in the writer's experience, to radium rays (*vide* Cases Nos. 8, 10, 5, 6).

Malignant disease of the vagina and cervix is favourably affected by radium treatment, and epitheliomas, if localised, can confidently be expected to disappear. Owing, however, to the difficulty of efficiently raying the more inaccessible portion of the growth, recurrence in these positions after a longer or shorter period of time is common. This can be again subjected to treatment, but as a rule less successfully than the primary growth, and this for two reasons. The one that the recurrence is probably situated in a less accessible position, as in an extension to the broad ligaments, the other that after a course of raying only those cells survive which are refractory to the rays, and a recurrence consisting of such cells or daughter cells is less susceptible to attack. There is a tendency by natural selection to breed cells which are immune. The same phenomenon can sometimes, though rarely, be observed in rodent ulcers, an extended ulcer attacking perhaps bone or mucous membrane after repeated raying does not respond at all. In these cervical cases, even though there should be recurrence, the patient has greatly benefited in the meantime by the removal of pain, the cessation of discharges, and the general gain in health and strength. This gain in general health may be striking, and equivalent, as some of the Continental authorities have termed it, to a virtual resurrection (Cases Nos. 13, 14, 15).

As observed in last year's report rodent ulcers require no detailed notice, for the beneficial action of radium is generally admitted. Uncomplicated cases situated on the skin and not too extensive for the amount of available radium invariably do well. If they recur, which may be due to an insufficient primary treatment, they easily yield to a second course and remain cured. The cosmetic result leaves nothing to be desired, and there is scarcely any subsequent contraction of the skin. They are less amenable when situated on mucous membranes. Though a single strong application may suffice to remove the rodent, the writer prefers, when it is possible, to divide the necessary dose into two or three administered at three or four days interval. It is important, in order to prevent a recurrence, that the deeper parts as well as the superficial should receive adequate treatment.

Seven cases of exophthalmic goitre, five females and two males, received radium treatment. All benefited save one, an acute case, who died in less than a month after the treatment of hyperthyroidism (Case 2). As mentioned in last year's report, indisputable benefit is occasioned without any necessary obvious change in the organ, though generally it is diminished in size. I would again draw attention to Rave's experiments (*vide* Colwell and Russ, "Radium and the X rays," p. 212) on cats and rabbits. He administered large doses of X rays to the thyroids of these animals, and found from subsequent histological examination that no recognisable changes had been produced. Confirmatory results have been obtained by others. It appears, then, that in the thyroid gland we have a structure which, so far as histological examination can carry us, is refractory to X rays, yet there is ample clinical evidence of the beneficial effects of irradiation in exophthalmic goitre. The following are brief notes of the more important cases treated, with the exception of rodent ulcers, which have been purposely excluded. Reference has also been made to one or two old cases whose progress it has been possible to follow.

Case 1.—Exophthalmic goitre in a male, aged 39, recommended by Prof. Gulland. Admitted 13th January, 1916. Duration six months. Tiredness, weakness, tremulousness, sweating, slight exophthalmos; pulse 110; thyroid, both lobes enlarged; neck 15¾ inches. By 7th September, 1916, this patient had received a total dose of 1,560 mgh. through silver 1·4 mm. thick, and so distributed over the gland as to avoid over-exposing the skin. A letter received from this patient, dated 26th October, 1916, states, "I am making progress since I came home, feeling altogether better. I have put on 9 lbs. in weight; my neck measures 14¾ inches; pulse 104. The feeling of tiredness and my walking and sleeping very much improved." On 7th December he returned, feeling very much better; has gained 1 stone 9 lbs.; neck 15⅜; can walk freely now, could not do that before. Gave him a further dose of 380 mgh. to the thyroid and 380 over the thymus.

Case 2.—Exophthalmic goitre in a female, aged 22, recommended by Prof. Gulland. Admitted 6th June, 1916. Duration over two years. Neck 14·3 inches; marked exophthalmos and extreme nervousness; pulse 115. Given 360 mgh. distributed and guarded as in previous case. Became worse, and died in July of hyperthyroidism and toxic phenomena.

Case 3.—Exophthalmic goitre in a male, aged 27, recommended by Dr. R. A. Fleming. Admitted 18th July, 1916. Duration ten months; neck 15½ inches; pulse 110; exophthalmos; choking feeling, and dyspnœa from pressure on windpipe; perspiration; nervous. Received 240 mgh. On 9th January, 1917, neck 15¼, better, less nervous, less pressure on windpipe, less perspiration.

Case 4.—Exophthalmic goitre (old case) in a female, aged 22, recommended by Dr. R. A. Fleming. Duration six years. Admitted 2nd March, 1915. Weakness, diarrhœa, nervousness, palpitation; pulse 125; exophthalmos; neck 13 inches; thyroid much enlarged. Patient has been under treatment, and has received 1,260 mgh. to thyroid, and 1,440 mgh. to thymus. On 12th December, 1916, she was remarkably better, all her weakness gone, able to walk and work, no diarrhœa, less nervous. Dr. R. A. Fleming of opinion that the thymus applications have had much to do with the improvement. Neck 14 inches. On 30th January, 1917, she continued well.

Case 5.—Parotid mixed cell tumour in a female, aged 34, recommended by Mr. Jardine. Admitted 12th September, 1916. History: two years ago a warty growth succeeded a mole on the left side of the face. This was removed in January, 1916, by Dr. Reid, of Inverness. In March a recurrence with stiffness of the jaw; Prof. Caird, in June, removed this and a gland. In August the swelling reappeared. On 14th September, 1916, there were three swellings, the larger one, the size of a small egg, beneath the left ear, the smallest one on the left side of the face, a larger one higher up. Radium was buried by Mr. Jardine in each of these, and a total dose of 6,125 mgh. given. On 2nd November, 1916, better, some scabbing, swellings gone. Mr. Jardine wrote: "An excellent result. I can feel little thickening at all now." On 11th January, 1917, Mr. Jardine wrote: "The condition is perfect." In June, 1917, Dr. Gillies, of Inverness, wrote: "There is no trace of a recurrence. I should like Prof. Caird to know, as he had said a year ago that he regarded the case as hopeless."

Case 6.—Round-celled sarcoma of parotid gland in a female, aged 40, recommended by Mr. A. Scot Skirving. Admitted 21st September, 1916. History: twelve years ago following mumps a small lump appeared which twenty months ago began to enlarge. Now a hard movable swelling in parotid region with shooting pain. Recently another swelling at anterior border of sterno-mastoid. Mr. Skirving operated on 12th September, and on 21st September buried radium in the wound until a dose of 3,000 mgh. had been given. 21st December, 1916—Both swellings have disappeared, patient seems quite well, and Mr. Skirving wrote to say that "he was very pleased with the condition as he thinks there is no trace of the disease left." 1st February, 1917—Patient continued well. 5th July, 1917—Patient has been delivered of a son. There is no trace of a recurrence of the disease.

Case 7.—Epithelioma of left fauces, posterior pharyngeal wall, and root of tongue in a male, aged 50, recommended by Dr. Logan Turner. Admitted 26th September, 1916. Disease started twelve months ago by small pimples, which later inflamed and formed a large sore. He was treated with mercury without result. Ten days ago he consulted Dr. Logan Turner, who did not recommend an operation, but suggested radium treatment. Patient suffers severe pain when swallowing. Can see an irregular nodular ulcer extending downwards and hard on palpation. On 28th September, 1916, patient was given a capsule of radium at the end of a rod to hold against the affected part during his waking hours. A dose of 1,920 mgh. was given. The jaw was now stiffer, and cannot be opened so far; the surface appears to be more excavated; greater dysphagia. On 30th November, 1916, the reaction was passing off. Dr. Logan Turner thought the radium had done some good Owing to the difficulty of holding the radium for long periods in the mouth, an attempt was made to bury a tube in the substance of the growth. On 16th December, Dr. Logan Turner introduced a small tube, which, however, came out again very soon. On 17th December, Dr. Turner reintroduced it, and it now remained in position until the dose amounted to 2,040 mgh. It was now removed. Patient said the pain had been eased by the treatment. He is to return in six weeks.

Case 8.—Myelosarcoma of temporal region involving orbital cavity in a male, aged 23, recommended by Prof. Gulland. Admitted 17th October, 1916. Duration three years. Began by headaches and swelling of jaw. A small operation was performed to remove the swelling. Later a tumour appeared on the right temporal region. On 7th July, 1916, Prof. Caird excised a fragment which was found by the pathologist to be a myelosarcoma. Prof. Caird refused to operate. On admission there was a prominent swelling over the right temporal region accompanied by shooting pain, difficulty in opening the mouth and strabismus. An X-ray showed that the frontal bone and upper jaw were involved. On 1st November, two radium tubes were inserted in Mr. Dowden's absence by Dr. White into the growth and external radium treatment was also begun. A total dose of 4,920 mgh. was administered. In a week's time the growth had diminished in size, the headache was better, and the jaw freer. On 28th November, 1916, there was no squint and no pain. Prof. Gulland examined him and wrote, "I was delighted to see the patient to-day, and to find that he had improved so very greatly. He looks immensely better, and I see no reason why he should not start work." On 23rd January, 1917, he continued quite well.

Case 9.—Scirrhus in a female, aged 59, recommended by Dr. David Huskie. Admitted 28th November, 1916. A year ago Prof. Caird removed patient's left breast for scirrhus. In the line of the scar there is an ulceration with hard borders. It has been burned by Dr. Huskie three times. This ulcer was given a dose of 205 mgh. during a fortnight. A week later Mr. Jardine examined her and wrote, "Result very successful, no more need for treatment." The ulcer and hardness had disappeared. Warned patient to report herself regularly to Dr. Huskie.

Case 10.—Recurrent sarcoma (old case) in a female of 49, recommended by Dr. Maclagan. Duration four years. Several operations for the removal of the growth without success. Admitted by Mr. Miles on 15th July, 1915. Now a large nodular mass projecting in the left suborbital region and adherent to the maxilla. Pathological report, large spindle-celled sarcoma. As Mr. Miles considered the tumour inoperable, radium treatment was commenced. By internal and external applications a dose of 5,880 mgh. was given. In November, 1915, she was readmitted. There was now an ulcerating mass closing the left eye; the mass was so friable that it was difficult to keep tubes embedded, but by external treatment a dose of 5,180 mgh. was given. During these applications the growth diminished markedly. On 1st February, 1916, the tumour had greatly shrunk and was movable it had been fixed before. Patient better and stronger and can see normally. The condition had so much improved that Mr. Miles removed what was left of the growth and further radium treatment was commenced. A dose of 4,120 mgh. was given as a prophylactic against recurrence. On 23rd November, 1916, the growth had disappeared, an area of dead bone was visible, the skin around healthy. Mr. Miles could detect no sign of recurrence. On 26th June, 1917, Dr. Maclagan wrote: "The patient's face is practically healed up. There was a little trouble with some bone sloughing away, but she is all right now and no trace of recurrence."

Case 11.—Sarcoma involving lower ribs on right side in a male, aged 44, recommended by Mr. Dowden. Admitted 15th May, 1916. Duration about eighteen months. On account of a swelling in the region indicated the patient attended the Surgical Out-Patient Department of the Royal Infirmary in October, 1915, and Mr. Jardine scraped the interior of the growth. The pathologist reported that the growth was a sarcoma. The growth never went quite away, and on 25th April, 1916, the patient was admitted to Mr. Dowden's wards. The tumour was now increasing, and as Mr. Dowden was of opinion that an operation would be an extremely severe one, he thought that radium might be tried. Over the growth there was a cyst containing blood. Radium treatment was now begun. Three tubes of radium were inserted into the substance of the growth, and a total dose of 7,560 mgh. was administered. On 14th June there was considerable external swelling and discharge. On 20th July the external swelling was less but there was more pain. The patient reported himself at regular intervals and appeared to be regaining strength, for on 21st November, 1916, he asked permission to resume his work as a brass-finisher. This Mr. Dowden permitted him to do. On 2nd January, 1917, he was well and hard at work, but above the original growth there was a hard tumour mass, which Mr. Dowden had noticed before.

Case 12.—Myeloma in a female of 23, recommended by Mr. Dowden. History: two years ago patient complained of a gumboil on the right side of the superior maxilla. Dr. Gibbs found a growth and recommended her to consult Mr. Dowden. The latter scraped out the cavity, and the pathologist reported the growth to be a myeloma. It lay posterior to the superior maxillary bone. As a prophylactic radium treatment was recommended, a tube of radium was attached to a wire and passed up into the cavity and a dose of 1,920 mgh. administered. This was in October, 1915. In February, 1916, there was no trace of a recurrence, but when the patient reported herself in June, 1916, Mr. Dowden found that the disease had returned. On 27th June Mr. Dowden scraped out the cavity and inserted radium tubes, at first three, but on one coming out only two were kept in. A dose of 4,400 mgh. was now given, more than double the dose she was given the first time. Precautions were also taken to attempt to maintain the radium in a more effective position. Very severe reaction followed with swelling and pain, which required constant opiates, the tongue and mucous membrane of the cheek being burned. In December the patient was much better, and on 2nd January, 1917, Mr. Dowden could find no trace of a recurrence.

Case 13.—Sarcoma of cervix in a patient, aged 47, recommended by Dr. Barbour. Admitted 20th July, 1916. Duration one year. Complains of a bearing-down pain and some discharge. On 26th June, 1916, the cervix, found to be ulcerated by Dr. Fordyce, was curetted. Pathological report, sarcoma. Dr. Barbour examined her on 20th July, 1916, and found hard nodules all round the cervix except posteriorly. The right ligament was thickened. Body of uterus unaffected. Hysterectomy unsuitable. A dose of 4,300 mgh. of radium was given. 26th September, 1916—Examined by Dr. Fordyce. Condition very satisfactory; there being no trace now of the indurated nodules, but cicatrisation instead. 14th November, 1916—Parts seemed quite healthy, no discharge, patient much stronger. Weight 8 stone 1½ lbs. 1st February, 1917—The patient was examined and the parts found to be *in statu quo*.

Case 14.—Squamous epithelioma growing from vaginal roof behind and to left of cervix in a patient aged 63, recommended by Dr. Orr and Dr. W. Fordyce. Admitted 16th October, 1916. There is a soft fungating gangrenous mass of the size of a Victoria plum occupying the above position. This was removed by operation and the base of it thoroughly scraped and pure carbolic acid applied. Pathologist report, squamous epithelioma showing marked necrosis. Ten days later, the mass had grown again to half its previous size, very fœtid discharge, same necrosis. The mass was again removed and radium applied to base and a dose of 4,900 mgh. administered.

11th January, 1917. — Dr. Orr writes: "There is to-day nothing to be felt except a cicatrix and the least suspicion of ulceration perhaps the size of a green pea at one point of the cicatrix. The patient feels and looks well and the result so far is very gratifying."

Case 15.—Epithelioma of the cervix. (An old case.) Patient aged 30, recommended by Dr. Brewis. Admitted 6th July, 1915. Complaint of loss of health and reddish brown discharge. Cervix widely involved, uterus fixed. After curetting, a dose of 6,720 mgh. of radium. 30th September—Patient much better. Pain disappeared. Cervical cavity smaller, granulations superficial, a scraping still showed squamous epithelioma cells. Uterus movable. In consequence of pathological report a dose of 1,920 mgh. was given.

3rd February, 1916. — Patient greatly improved, looks another woman.

20th July, 1916.—Quite well. Uterus shrivelled, replaced by granulation tissue. Pathologist's report from a scraping.

16th November, 1916.—Returned to ward, complaining of continuous pain in right leg. Examined by Dr. Brewis under chloroform. Cannot feel cervix or body of uterus, but to the right there was a hard mass in the position of the broad ligament extending back to the sciatic notch to the bone. The mass is a good size and fixed. A scraping showed malignant cells. A dose of 6,500 mgh. of radium was administered.

14th December, 1916.—Rise of temperature. Examination showed that the opening to the cavity was blocked. A drainage tube was introduced.

15th January, 1917.—A slough came away. Temperature still rises, but less, pain also less and only felt at night. Patient remains in a prostrate condition, due to the disease and to the destruction produced by the radium.

2nd February, 1917.—Patient remains *in statu quo.*

Case 16.—Chondro-fibro-sarcoma in a boy, aged 6, recommended by Dr. J. S. Fraser. Admitted 9th May, 1916. The disease affected the left maxillary antrum, causing protrusion of the cheek, diplopia, and proptosis. Dr. Fraser removed as much as was possible of the growth by scraping, but fearing that he had not eradicated it, consulted with Mr. Dowden with a view to the removal of the left superior maxilla. Mr. Dowden, however, was of opinion that the case was more suitable for radium. Tubes of radium were introduced through an opening into the mouth, and a dose of 1,440 mgh. administered. The patient was examined on 3rd January, 1917, by Dr. Garretson, in the absence of Dr. J. S. Fraser, and he was unable to detect any sign of the disease. The boy appears to be perfectly well and is attending school.

Case 17.—Myeloma of the sternum (old case) in a male, aged 32, recommended by Prof. Gulland. Admitted 9th March, 1915. Duration two years. Growth the size of a large cocoanut, adherent to sternum. Symptoms, weakness and dyspnœa. Consultation with Mr. Miles, who considered the case inoperable. Four radium tubes were introduced by Mr. Miles into the growth, and radium was also applied externally. A dose of 13,200 mgh. was administered. Within a month of this treatment the growth had entirely disappeared. Prof. Gulland remarked, in regard to this case, "that he had watched the tumour growing during the past eighteen months, that it was of very large size, quite as big as two fists, that he had been rather a sceptic as regards the value of radium in malignant disease, but that he was now quite converted. The growth was a myeloid sarcoma." The patient recovered his health and strength, and went back to work. Six months later a small recurrence appeared over the sternum. After a dose of 250 mgh. it disappeared, but was followed by an ulcer about one inch deep, extending into the eroded sternum. No pain was associated with the ulcer, which slowly filled up. The patient had a course of iodide of potassium, on Mr. Miles' advice. The patient was able to continue with his work. On 13th January, 1916, Prof. Gulland wrote: "This patient had a long course of inunction and of iodide of potassium before the radium treatment, but without the slightest effect. The ulcer has impressed me more as a continued destruction of the tumour, which must have started from the centre of the sternum." The foregoing appeared in last year's annual report. The further history is as follows: In February, 1916, a swelling occurred in the left axilla, which was removed by Mr. Miles in March, 1916. The pathologist's report was the following: "A difficult growth to classify. There is a large amount of well-developed fibrous tissue. The cells have a tendency to arrange themselves in rounded follicles. They are polygonal in shape, and suggest endothelial cells in appearance and arrangement. The condition I regard as a tumour formation belonging to the group of the lymphosarcomata, but somewhat anomalous in character." 26th October, 1916—The ulcer on the sternum is quite healed, and the patient perfectly well. In June, 1917, patient remained quite well.

REVIEW.

X-Rays. G. W. C. Kaye, M.A., D.Sc. (Longmans, Green & Co., 1917. 9s. net.)

The second edition of this volume, useful alike to the medical worker and the physicist, is somewhat larger than the first issue, the main additions being in the chapters dealing with X-ray tubes, the diffraction of X rays, and the nature of the rays; an entirely new chapter summarises the main requirements for a radiographic installation. The alterations in chapter XIII, dealing with the diffraction of X rays, greatly enhance the value of the book by providing a short but comprehensive summary to date of this important branch of X-ray investigation. The account given in the first edition was necessarily somewhat incomplete, as at the time of its publication several important researches were in progress; the results of these have been dealt with in the later edition. The Laue method of investigating crystals retains a position of somewhat more prominence than needful, for although of historical interest the great difficulty of interpretation of the complex results has led to its entire replacement by the X-ray spectrometer method due to Prof. W. H. Bragg and his son. A useful chapter on "X-Ray Equipment and Technique," by Mr. W. F. Higgins, has been added. Without being in any way exhaustive, it gives what one may term the minimum requirements of an installation for fluoroscopic and radiographic work. In the section upon X-ray tubes we should like to have seen some mention of the Coolidge tube, the advent of which brings the standardisation of radiographic technique one step nearer realisation.

The general excellence of style of the book remains unchanged, some additional diagrams and photographs of interest have been included, while the index has been revised to embrace the later alterations. It is pleasing to see that Capt. Kaye has been able, notwithstanding his military duties, to retain one of the most valuable features of the original book, by incorporating the very latest developments of the physical aspects of the science into a connected account, which may be read with pleasure and profit by an individual of average scientific attainment.

NOTES AND ABSTRACTS.

RADIO-TECHNIQUE.

Dangers in the Roentgen Laboratory.—J. S. Shearer (*American Journal of Roentgenology*, July, 1917, p. 357).—When a patient is on an insulated table his body becomes gradually charged by leakage from the high tension wires through the air. If he is touched by the earthed operator the charge escapes to earth, and, as a rule, this is not dangerous though it may alarm a nervous patient. This, as is well known, can be avoided by earthing the metal table. Shearer points out that there is an erroneous idea that this earthing ensures the safety of the patient, while in reality the reverse is the case.

The danger is greatly increased by contact or proximity of any part of the body to earthed metal. If the charge cannot leave the body after reaching it, no current can be set up. Contact with a high tension circuit at one point, when well insulated from earth or the other wire, is not dangerous, because only a slight static charge can accumulate on the body.

The patient acts as a conductor between the high tension wires and the earthed table, and the only safety lies either in keeping all portions of the wire at a much greater distance from the patient than the sparking distance from either wire to earth, or in placing a good insulator or an earthed conducting shield between the tube and patient. Such a shield, which would prevent the patient's limbs from coming too near the terminals of the tube, is most useful.

The danger of using an earthed metal table does not, however, apply to screen work when the table is between the tube and patient, provided the connecting wires are well insulated and not brought down close to the patient; the table acts in this case as a protection.

Shearer is convinced that a metal table should never be used in treatment work, and even thinks it too dangerous for radiographic work.

Earthing the tube stand, he points out, does not decrease the danger to the patient but may increase the danger of tube puncture.

He also points out that the use of circuit breakers and fuses in the primary circuit may give rise to a false feeling of security. They act relatively slowly, especially the fuses, which often carry from 50 to 100 per cent. overload for some time before blowing, and consequently would not prevent serious injury being done. R. W. A. S.

The Action o. X rays on Plate, Pastille and Skin.—J. Remer and W. D. Witherbee (*American Journal of Roentgenology*, June, 1917, p. 303).—When Shearer's formula

$$\frac{\text{Current} \times \text{Voltage} \times \text{Voltage} \times \text{Time}}{\text{Distance} \times \text{Distance}}$$

for the measurement of X-ray intensity by photographic methods is applied to X-ray dosage as recorded by the pastille, the authors find experimentally that the formula does not constantly hold good.

In unfiltered dosage they find that by doubling the spark gap the dose is doubled, other factors remaining constant.

In filtered (3 mm. al.) doubling the spark gap doubles the dosage as in unfiltered, but doubling the distance gives one-half the dose instead of one-quarter.

These experiments on the relation between the pastille readings and the skin erythema appear to them to indicate that the action on the pastille coincides with the biological effect on the skin. They, therefore, state that the spark gap as a factor in its effects on the skin and pastille is only half as active as on a Kienboeck strip or X-ray plate. The latter may indicate more accurately the amount of rays reaching the part, but, from the therapeutic point of view, the biological effect is the more important.

The skin erythema of two areas is identical, when the spark gap of the original is doubled and one-half the time is taken, other factors remaining constant.

The authors point out that the Holzknecht radiometer was not originally intended for filtered treatments, yet it is being used in giving deep cross-fire treatments.

R. W. A. S.

RADIO-DIAGNOSIS.

The Roentgen Diagnosis of Bone Tumours.—I. S. Hirsch (*American Journal of Electrotherapeutics and Radiology*, June, 1917, p. 276).—The author in this well illustrated paper discusses the diagnosis of various bone conditions.

A distinction between myositis ossificans, and periosteal sarcoma is that in the latter the feathery trabeculæ radiate from the bone at right angles, diminishing in density as they extend outwards, while in myositis they are parallel to the muscle fibres and increase in density as they extend outwards.

A true cyst is usually central, occupies the entire transverse section of the bone, is not surrounded by an area of bone sclerosis, and contains no sequestrum.

Multiple cystic formations may occur in such systemic diseases as osteitis deformans, multiple myeloma and osteomalacia. They are not true cysts but localized areas of cortical rarefication.

In osteitis fibrosa the form of the cysts is not as spherical and symmetrical as that seen in isolated cysts, because the condition is really due to an enlargement of the Haversian canals into lacunæ with a coalescence of these lacunæ. In addition, examination of the other bones will show the other changes in this disease, the cortical thickening, the bowing and the enlargement of long bones and hyperostoses and thickening of flat bones. This disease may occur in children or it may take on a mono-osteitic form, the tibia being most commonly affected.

Multiple myeloma is characterized by widely scattered tumours arising in the medulla of the bones in elderly people. There is absorption and trabeculation of the cortex, with thinning and elevation of the periosteum. The vertebræ, ribs and sternum are chiefly affected, and the periosteal outline is usually maintained.

In chloroma, chiefly affecting children, numerous areas of osteolysis may be found in the bones. Starting in the marrow, the tumours invade the cancellous tissue and involve the periosteum. The resulting circular areas of osteolysis may coalesce, forming large areas of defect in the bone. When involving the long bones the pseudo-cystic areas usually found about the epiphyseal lines simulate osteitis fibrosa.

Multiple bone cysts may occur as a result of osteomalacia. This is found most commonly in the femur, radius and ulna, and in addition there is bowing of the bones. The cysts are due to absorption of bone and perforation and decomposition of the trabeculæ. R. W. A. S.

Diagnosis of Bilharzia Infection of the Urinary Tract by Radiography.—G. O. Lotsy (*Archives d'Electricité Médicale*, May, 1917).—About a year after infection the ova, having infiltrated the walls of the urinary passages, become calcified. At this stage they produce an opacity to the X rays. The author has seen—and shows skiagraphs of—two cases which were diagnosed only on the result of radioscopic examination.

The first was sent for examination for calculus, but showed an oval outline of opacity surrounding a slightly dark area. Unable to explain this, the cystoscope was used and revealed a typical bilharzian condition. The shadow was due to the calcified ova in the bladder wall in an advanced stage of the disease.

In the second case cystoscopy had not favoured this infection, and an imported ureteral calculus was suspected. Radiographic examination showed two shadows, one of calcareous infiltration of the bladder wall, the other of the ureter. The diagnosis of bilharzia was subsequently confirmed by microscopic examination of the urine.

N. B.

Gas Infection and Radiographic Examination.—Massimiliano Fiorini (*Radiologia Medica*, IV. 7-8, 1917).—The relative frequency with which gas infection has been observed by X-ray examination deserves to have been noticed by more authors than has been the case, and the subject is peculiarly important to surgeons.

Many cases of gas gangrene may exist for some time without easily recognised symptoms or signs. In these a good radiograph, well interpreted, can often give early diagnosis and so lead to the taking of necessary precautions. In many of the author's cases the X rays alone revealed the infection, and would have led to cure if the necessary importance had always been attached to his observations.

The radiographic appearance of gas depends on the seat of infection and on whether it is localised or diffuse. In connective tissue there are seen small spots, while in muscle there is striation in the direction of the fibres. The appearance of the gas phlegmon is particularly obvious near the seat of a fracture or piece of projectile.

To obtain a good and easily read picture it is necessary to give a long exposure with a very soft tube. The author gives ten instructive examples of the radiographs obtained. N. B.

Pneumonoconiosis.—W. W. Boardman (*American Journal of Roentgenology*, June, 1917, p. 292.)—The author reviews the literature and recorded cases of this condition, and describes three which came under his own notice. Cases of pulmonary fibrosis resulting from chronic dust inhalation might, he thinks, be divided into three groups.

The first would include at least some of the cases of diffuse and uniform thickening of the linear markings and trunks so familiar to every radiologist. These are difficult cases for diagnosis, the uniform character and distribution of the process being the most valuable points of differentiation. The absence of studding is of doubtful value, since nodular areas are produced in pneumonoconiosis which, from their character and location, must resemble the "studdings" of pulmonary tuberculosis. The absence of "interweaving" seems also of doubtful value in differentiation, but further study, controlled by post-mortem examination, will be necessary to settle this point.

The second group would include the so-called typical cases, which should be readily recognised if one bears in mind the uniform size and even distribution of the areas of increased density.

In the third group are the cases with marked and extensive pulmonary infiltration. These are the most difficult to diagnose. The shadows are too dense to allow satisfactory stereoscopic study, and no individual areas are distinguishable owing to the density of the process. Differential diagnosis must rest on a careful study of the history and the clinical course of the disease, but absolute diagnosis cannot be made during life. One feature of the skiagram in this type is the apparent uniformity of the stage of the process, no area appearing more advanced than another.

Boardman concludes by saying that it seems quite definite that chronic dust inhalation may produce a pulmonary fibrosis that results in a radiographic picture closely simulating early, miliary or advanced fibroid tuberculosis.

R. W. A. S.

RADIUM.

An Investigation of Radium Luminous Compound.—C. C. Paterson, J. W. T. Walsh and W. F. Higgins (*Proc. Phys. Soc. Lond.* Vol. XXIX, pp. 215–249, June, 1917).—The paper gives an account of certain investigations, undertaken at the National Physical Laboratory, to devise satisfactory means of measuring the luminosity of instrument dials painted with radium luminous compound. The first part deals with the luminosity and radium content of the luminous compound before its application to the dial. The material, consisting of a mixture of active zinc sulphide and from 0·02 to 0·04 per cent. of radium bromide, is tested as a dry powder and must be examined in a closed glass tube to avoid the escape of emanation. The full luminosity is not reached for some days after mixing, and sufficient time must therefore elapse before the measurements are made. The photometer consists of a sheet of white matt celluloid placed at approximately 45° to a photometer bench and viewed at right angles to the bench by a low-power telescope. A rectangular hole with sharp edges is cut in the celluloid and the tube of luminous material is placed immediately behind this hole. A square luminous patch will then be seen in the field of view of the telescope due to the luminous compound. The surrounding surface of the celluloid is illuminated by light from the standard lamp on the photometer bench, after traversing a green filter; variations of this illumination are obtained by moving the lamp to and fro on the bench and also to a small extent by changing the voltage on its terminals. Equality of brightness between the central square and the surrounding field is thus obtained, and from a knowledge of the candle-power of the lamp, its distance from the photometer and the constants of the apparatus, the luminosity of the sample in foot-candles can be calculated.

The radium content of the mixture is measured in the usual way by the gamma ray method, a small standard is employed and allowance is made for the absorption of the gamma rays in the zinc sulphide and in the glass containing tube. The sample must, of course, be hermetically sealed to prevent the escape of emanation, and furthermore, must be kept in this condition for about 20 to 30 days in order to allow the equilibrium amount of emanation to form. The absorption correction was obtained by mixing a known quantity of radium with zinc sulphide in the usual proportions and measuring the resulting gamma ray activity.

The determination of the luminosity of painted dials presents a somewhat different problem to that of the luminous compound, as a continuous luminous surface of sufficient area is not usually available. The method devised is virtually a comparison of the dial under test with a pair of "artificial dials" whose luminosity can be varied at will until a match is obtained. These "artificial dials," are made by cutting stencils to correspond with the various types of dial to be tested. For each standard type a separate pair of stencils is cut to the exact dimensions of the luminous markings. The stencils are placed in front of a translucent screen, which is illuminated by an electric lamp with a suitable green filter interposed. The candle-power of the lamp is varied by means of a resistance in the supply circuit, while a precision ammeter enables the current to be determined. The instrument is standardised by the use of a surface brightness photometer for various currents through the lamp, the stencils being removed while this is done. A series of preliminary tests on dials, the painting of which was regarded as satisfactory, enabled a standard surface brightness to be adopted and the luminosity of the dials tested is expressed as a ratio of this.

In connection with the luminosity of dials tests were carried out to ascertain the best dimensions of the markings to secure maximum legibility. The conclusion reached was that the proportion of the width of line to height of letter should be about 1 to 8 for letters and figures of which the height exceeds 5 mms. Below this limit experience suggest that the breadth of line may be usefully increased to about one-sixth of the height of the marking.

Systematic tests soon showed that the luminosity was not constant, but that it decreased with time. Nine samples were kept under continued observation over periods up to fifteen months. The luminosity of the standard quality of compound (0·04 per cent. of radium bromide) gradually increases to a maximum for the first fifteen days after mixing, it then begins to fall at a rapid rate, which becomes slower as time goes on. The rate is approximately exponential for about 200 days, but after this is somewhat less than would be expected according to such a law; eventually the luminosity becomes approximately constant at the end of about 500 days; its value then is, however, only one-fifth to one-fourth of the maximum brightness. For samples containing a smaller proportion of radium the initial brightness is in the ratio of the radium content, but the rate of decay of the weaker compound is slower, with the result that the ratio of the luminosities gradually approaches unity as time goes on. For painted dials the luminosity of the markings is much smaller than that of the compound employed (about one-third), and the rate of decay is correspondingly slower. In consequence, to obtain a bright effect for a comparatively short period (up to a year) a radium content of 0·04 per cent. may be profitably employed, but for instruments in which a lower initial brightness suffices, a much longer useful life is obtained by the employment of 0·03 or even 0·02 per cent.

material. From considerations of initial expense this point is of considerable importance.

W. F. H.

ELECTRO-DIAGNOSIS.

The Paradoxical Extension and Flexion of the Hand and Fingers on Unipolar Faradic Stimulation of the Forearm.—Cristofero Pastine (*Policlinico*, XXIV. M. 7, July 1st, 1917).—At a meeting of the Neurological Society of Paris, in July, 1917, Babinski drew attention to the following conditions:—(i.) In paresis of the median nerve, unipolar stimulation of the upper part of the anterior surface of the forearm produces flexion, while stimulation of the lower part of this surface causes extension, contrary to the normal response in this position on the healthy side. (ii.) Similarly, in paresis of the musculo-spinal group, bipolar faradic stimulation of the extensor muscles, or unipolar stimulation over the nerve, produces extension, while, contrary to the normal, unipolar stimulation of the postero-superior surface of the forearm causes flexion.

Huet argued that this was simply due to hypo-excitability of the damaged nerve and resulting hyper-excitability of the sound nerves, and could be seen in any part of the body and was not confined to forearm.

The author adduces the following facts in suggesting his own explanation of these paradoxical reactions.

In normal limbs weak or medium strengths of unipolar faradic excitation of the upper third of the back of the forearm produces varying results in different individuals. Flexion is often produced unless the electrode is accurately placed over the motor points, and sometimes even then a weak current will result in flexion. Stimulation of the lower third nearly always evokes flexion. Even a weak galvanic current has the same result; in the upper area K.C.C. in particular produces flexion while A.C.C. may have an extensor response.

Stimulation of the normal anterior surface never produces extension. He therefore suggests that these responses are a sign of the functional superiority of the flexor muscles over the extensors, whereby they are normally more excitable.

When in musculo-spinal paresis stimulation of the postero-superior third of the forearm results in flexion, it must be judged in the light of the reactions on the normal side, which may be a similar but weaker flexion.

Moreover, this paradoxical flexion may be diminished, or even converted into extension by a stronger current, more carefully localised and concentrated on the motor points. With galvanic stimuli one can also procure flexion with either pole, but with negative rather than positive, which may actually give weak extension.

In paresis of the median stimulation in the lower third by either current may give paradoxical extension, but this is less constant and pronounced than in the opposing muscle group.

In actual *paralysis* of the median or musculo-spinal, when there is reversal of polar responses, it is often observed that, contrary to the normal or paretic behaviour, the electrical stimulation diffuses the antagonistic muscles more easily with negative than positive, provoking the typically sluggish contraction. The author claims, therefore, that when inoperation or simulation is suspected, an examination for these paradoxical reactions and comparison with the normal side may be helpful. One may also consider the increased faradic and galvanic excitability of the antagonists of paretic muscles. The difference from the normal side is always seen on comparison, and is more pronounced according to the degree of paresis. N. B.

ELECTROTHERAPY.

Notes on Ionic Medication and the Method of Administration.—L. Kesteven (*British Medical Journal*, September 29th, p. 423).—In the writer's experience, resolution of inflammation, release of adhesions, and general bactericidal action, are the things to be aimed at in dealing with diseases of the ear, and the great value of ionization lies in its sclerolytic effect. To ionize the tympanum, the patient's head should be placed sideways on the table and the external meatus filled with the solution. A small probe insulated to its tip is used to carry the current into the solution. He has found a 2 per cent. solution of alum useful in relaxation of the tympanum.

Great relief may be obtained in all classes of middle-ear catarrh with a 30 per cent. solution of zinc iodide. Zinc iodide is a colourless and stable compound made by boiling zinc and iodine together in water in the proper proportions. It is non-irritative and soothing, and to get the benefit of both the elements the current must be occasionally reversed.

Many mastoid cases, he thinks, if taken at a reasonably early stage, could be arrested and operation avoided by ionization with an absorbefacient bactericide such as a 1 in 500 solution of mercuric iodide.

In acute tonsillitis, using a curved aluminium probe insulated to within half an inch of its end, and round which cotton wool is wound, and dipped frequently in 5 per cent. zinc iodide solution, he passes 15 to 20 ma. through the tonsil for five to ten minutes. There is speedy relief from pain, and the tumefaction rapidly subsides. R. W. A. S.

ANATOMICAL CLASSIFICATIONS.

The Relation of Bodily Habitus to Visceral Form, Position, Tonus, and Motility. —R. W. Mills (*American Journal of Roentgenology*, April, 1917, p. 155).—This article contains an elaborate analysis (not yet completed) of a large number of cases examined by orthodiagraphy, photography, etc. The author points out clearly how the visceral form varies with the habitus of the body, and shows how fallacious it must be to form an opinion from a single type as the normal.

Mills divides his cases into two dominant types—the hypersthenic and the asthenic. Subjects of the former type, he says, are of massive, and powerful physique, great body weight, and heavy, bony framework. The most striking characteristic is the short, wide, deep thorax and long abdomen of great capacity in its upper zones. The intercostal angle is very obtuse. The lung fields are wide at the base and contract sharply to their apices, which project but little above the clavicles. The long axis of the heart is nearly transverse. The alimentary tract is high in position, corresponding to an abdominal cavity whose upper capacity is greatest, and the stomach is almost thoracic. The pylorus is the lowest or almost the lowest part of the stomach. Gastric motility is the fastest and tonus the most marked of any type. The colon is high in position and short. The cæcum is well out of the iliac basin even with the patient standing. The transverse colon is truly transverse. The descending colon is proportionately long owing to the high position of the digestive tract and straighter than in other types.

Subjects of the asthenic type are of frail, slender physique, light in body weight and of delicate bony structure. The chief characteristics of this type are a long narrow thorax and short abdomen, especially a disproportion between the great pelvic capacity and that of the upper abdomen. The pelvis of the pure asthenic is often as wide and capacious as that of a hypersthenic subject of more than twice his weight. The thorax is long in its longitudinal dimensions. The intercostal angle is narrow, and, as a rule, there is no ensiform. The lung fields are widest in their upper zones, the apices extending well above the clavicles. The diaphragm slopes downward. The heart is pendent, its long axis approximately in that of the body median line and having the form known as drop-heart. The stomach is atonic and is often largely pelvic when the individual is standing. Small and large intestines are low in position. The colon is long, the cæcum capacious, the degree of tonus of the entire gastro-intestinal tract is poor and its motility the slowest of any type. The stomach is frequently not empty within six hours after a standard contrast meal.

The author, however, does not mean to suggest that such a condition as visceroptosis does not occur, but considers that before assuming such, visceral topography must be judged on a type standard, founded on the results of a study of large numbers of subjects of similar type.

Whilst these are his two dominant types the author has intermediate types—sthenic and hyposthenic—and these are even further split up into sub-types.

In conclusion, the author says that a type classification affords a degree of diagnostic accuracy that will never result from a one-type standard, and, though far from perfect, he believes it promises an advance over our former ideas. R. W. A. S.

PUBLICATIONS RECEIVED.

Books.

The Cause, Prevention, and Treatment of Cancer and other Diseases. By Lieut.-Col. Wm. Hatton Hildebrand, late Indian Army (Retired).

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American Journal of Electrotherapeutics and Radiology, Oct., 1917.

American Medicine, Oct., 1917.

Archives de Electricité Médicale et de Physiothérapie, Nov., 1917.

Archives de Médecine et de Pharmacie Militaires, July, Aug., Sept., 1917.

Boston Medical and Surgical Journal, Nov. 22nd, Dec. 6th, 13th, 1917.

Bulletin of the Johns Hopkins Hospital, Nov., 1917.

Cleveland Medical Journal, Nov., 1917.

Gaceta Médica Catalana, Nov. 30th, Dec. 15th, 1917.

Good Health, Dec., 1917.

Journals—*continued.*

Interstate Medical Journal, Oct., Nov., 1917.

Journal of Cutaneous Diseases, Oct., 1917.

Journal de Radiologie et d'Electrologie, Sept., Oct., 1917.

La Radiologia Medica, Nov., Dec., 1917.

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New York Medical Journal, Nov. 10th, 17th, 24th, Dec. 1st, 8th, 1917.

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Norsk Magazin for Lægevidenskaben, Dec., 1917.

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Proceedings of the Royal Society of Medicine, Nov., 1917.

Ugeskrift for Læger, Nov. 15th, 22nd, 29th, 1917.

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ARCHIVES OF
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ELECTROTHERAPY

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THE EXTRACTION OF A FOREIGN BODY FROM THE BRAIN.

By H. H. Rayner, F.R.C.S., Capt. R.A.M.C.(T.), Hon. Assist. Surgeon to Manchester Royal Infirmary; and

A. E. Barclay, M.D., Capt. R.A.M.C.(T.), Medical Officer to X-Ray Department, Manchester Royal Infirmary.

The damage that is necessarily done to the brain structure in the removal of a foreign body, coupled with the fact that experience has shown that fragments lodged in the brain may give rise to very little disability, argues for leaving deep seated ones in position until such time as it becomes evident that their presence is the cause of the symptoms and that removal, if it can be effected, will lead to an improvement in the patient's condition.

History of the Case.—Patient, a man aged 20, was wounded 7th February, 1917. Note from C.C.S.: "Several small wounds in neck and back of head. Semi-conscious and suffering from shock. Vomited on the way down to the C.C.S." X-ray report stated that there was a small foreign body in the brain and some damage to the occipital bone. Kept in C.C.S. and base hospital in France for seven weeks and improved considerably. Then transferred to England. On admission to the 2nd Western General Hospital his condition was poor, with marked mental dulness, slowness and hesitancy of thought and speech, and somewhat childish mentally. Could not sit up for more than a few minutes, and suffered from intense headaches. Seemed to have some difficulty in opening his eyes and in bringing his mind to bear on anything. The tendon reflexes were all increased in the left arm, and there was definite weakness of the left arm and leg. There was slightly increased knee jerk and very marked ankle clonus. The signs and symptoms all suggested a sub-cortical lesion in the right Rolandic area, and the X-ray examination confirmed this view, a foreign body being located in the suspected region. For three months he was kept under observation and symptoms became more marked. Any effort was followed by marked clonic spasms, and he was quite unable to sit up. He also complained of a burning pain over the right side of the head.

It was evident, and also the patient knew, that he was getting worse, both mentally and physically. He was therefore transferred to the Manchester Royal Infirmary for investigation and consideration as to the possibility of operative interference. He was again X-rayed and the foreign body was localised as two inches deep from the scalp beneath the Rolandic area of right side (Fig. 1); the damage in the occipital region was no longer noted in the X-ray plates. In view of the fact that the patient had steadily become worse since admission, it was decided to attempt the removal by means of a special instrument described by one of us (A. E. B.) before the electrotherapeutic section of the Royal Society of Medicine.*

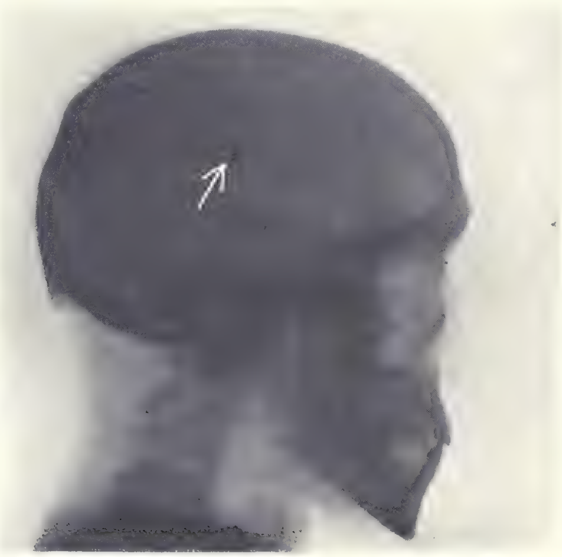

Fig. 1.—Small foreign body lying 2 ins. deep from the scalp under the Rolandic area.

The Operation, June 26th, 1917.—The foreign body was re-localised as two inches deep, and a skin mark was made on the right parietal region just before the operation in the theatre (by H. H. R.). The position of the skin mark corresponded to a point about half an inch behind the lower third of the fissure of Rolando. The fragment was small, but it could be seen on the screen fairly well. The patient was then taken to the operating theatre and anæsthetised. The bone was marked through the skin mark by a fine drill, and then the flap was reflected. A one-inch trephine was then used, taking the bone mark as the centre, and the opening enlarged slightly above and below. In order to assist in the repositioning of the patient on the X-ray couch, small screws were put into the skull on either side of the opening. The patient was then taken to the X-ray Department and the head replaced in the same position in which the skin mark had been made, the shadow of the foreign body falling exactly between those of the two small screws. A small horizontal incision, $\frac{3}{4}$-inch long, was then made in the dura, and the point of the extractor placed in position (by A. E. B.). With the lights out, the extractor was then manipulated so that the shadows of the fragment and of the points of the extractor fell exactly in the middle of the small fluorescent screen attached to the instrument. With the lights up, the point of the extractor was allowed to descend almost to the depth of the fragment (two inches), a small band of rubber tube having been placed on one of the blades to mark this distance. Then, with lights off, the blades were gently opened, to see that the shadows of the fragment and the extractor points still corresponded to the centre of the fluorescent screen. Seeing that the direction was correct, the blades were allowed to descend to the full length and very gently moved about to "feel" the foreign body. Almost at once the bell attached to the instrument gave a slight ring, showing that the metal had made contact across the blade points, and that by raising the points very slightly, then opening sufficiently and descending, the fragment should come in between the jaws of the extractor. This manipulation was carried out and the shadow was again seen between the blades. On closing the blades the bell at once rang continuously, showing that the fragment had been caught. With the lights on, the instrument was gently withdrawn, and in the middle of the clot of blood that came away was the small foreign body. (Fig. 2.)

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* "Proc. Roy. Soc. Med., 1916." Vol. IX (Elect. Therap. Sect.), pp. 75-89. *Ibid*, 1917. Vol. X (Elect. Therap. Sect.), p. 103.

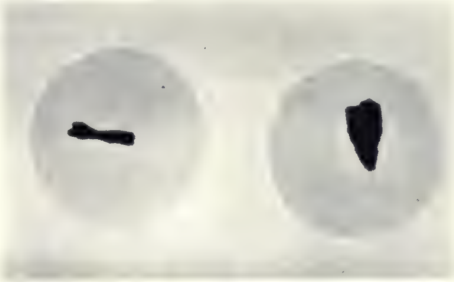

Fig. 2.—Actual size of the foreign body.

The patient was then taken back to the operating theatre, where the incision in the dura was brought together and the opening in the skull closed by replacing the piece of bone.

A small quantity of clear cerebro-spinal fluid came away when the extractor was inserted to its full depth, suggesting that the fragment lay in the lateral ventricle, and this was again suggested on examination of the fragment ; it was partially covered by a deposit of what appeared to be lime salts.

From the transverse measurement of the skull, the foreign body lay slightly over half an inch from the mid-line of the brain.

In the X-ray Department it took perhaps five or ten minutes to reposition the head accurately, the extraction of the fragment occupied about three minutes. The slight extent of the disturbance to the brain may be judged by the fact that there was no paralysis, even on the following day.

After History.—The shock of the operation was not so severe as expected, and even on the following day the patient could move both the hand and foot fairly well. There was no paralysis of any part, and within a week the power of the grip was as good as before the operation. Recovery of power continued and the mental condition became very much clearer ; it was evidently less effort to think, and the patient himself stated that he felt that he was getting better. He was able to sit up in bed without any ill effect, and the clonic tremors were less frequent and not so easily brought on. The wound healed rapidly and the trephine disc united to surrounding bone firmly. A few weeks after operation he was able to stand and walk a few yards without assistance. On August 30th, 1917, the patient was transferred to a Red Cross Hospital, but the journey in the ambulance seemed to cause a set back for a time. Attempts to stand brought on the clonic spasms which were also induced even in bed by slight causes. The grip was less strong and there was very slight paresis of the facial muscles. Improvement has again gradually taken place, and he is now (October, 1917) very much in the same physical condition as before he was transferred, but the mental condition is now much sharper and there is less hesitancy in speech and thought. There is no trace of facial paresis, the grip is fairly strong, he sits up for half the day, and can walk about the room without assistance. He is evidently recovering quite satisfactorily though slowly.

The Extractor.—The extractor is made like a pair of dental forceps, the jaws being about 1½ inches apart when closed. Above the jaws is fitted a small fluorescent screen. Beaks or blades are fixed at right angles to the jaws and meet at the points, but are insulated from one another by a small fibre block, let into one of the blades, which is made slightly longer than the other (See Fig. 3). For brain work the blades are thin and close together, the point of the longer blade being rounded. For the removal of foreign bodies from ordinary tissues stronger blades are used, the point being fashioned like a blunt dissector, so that the instrument can dissect, and by opening the blades separate its own way down after the skin incision has been made. The blades are connected with an electric bell, through a relay that is specially fitted in order to avoid stimulation of structures when contact is made. When the blades are brought into the correct relationship with the foreign body (see inset on Fig. 3), *i.e.*, with the longer blade alongside and the shorter blade touching the top of the fragment, contact is made and the bell rings. This indicates that by raising the blades very slightly and opening, the foreign body can be picked up without any intervening structures being also caught.

Protection, additional to that of the diaphragm, tube, box, etc., is afforded by a sheet of heavy X-ray-proof rubber with a three-inch hole in it that is placed either above or below the patient.

Note on the Use of the Extractor.—The use of this instrument is not easy ; like other surgical instruments it requires practice. It also requires experience in the interpretation of X-ray shadows. When the foreign body can be seen it looks so simple to pick it up with the points of the extractor, which can also be seen in the fluorescent screen. And it is simple, in suitable cases, provided that the operator recognises that it is absolutely essential to make an *exact start* directly over the foreign body and move the points of the extractor *exactly* in the line of the rays, *i.e.*, straight to the foreign body, correcting his direction as he proceeds towards it.

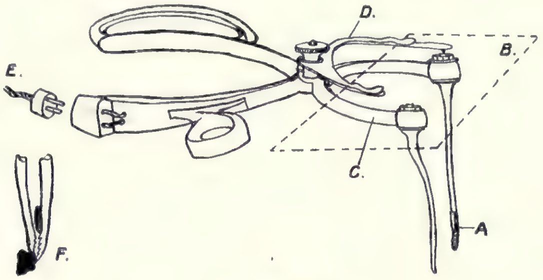

Fig. 3.

A. Prongs.
B. Fluorescent screen in dotted outline.
D. Screen holder, which also gives the contact to the insulated blade.
E. Wires passing to the bell circuit.
F. Inset. Larger view of the prong points in contact with a foreign body, showing the position in which contact is made.

It is not an instrument for anyone to use. It involves exposure to X rays and must be used by or in co-operation with a competent radiologist, who is experienced in radiotherapeutics, and who knows where the danger zone from X-ray dermatitis begins and how to protect not only the patient but also the operator.

A STUDY OF THE INTER-RELATION BETWEEN THE RADIOGRAPHY AND SURGERY OF GUNSHOT WOUNDS OF THE HEAD.

By Captain H. E. Gamlen, R.A.M.C. and Captain S. Smith, R.A.M.C.

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(*Continued from p.* 251.)

III. Classification of the Types of Injuries Revealed by Radiographs in Respect of the Need for Surgical Interference.

1. *No Fracture to be seen by X rays.*—Previous to the introduction of the helmet, these wounds could be safely left without surgical interference, and we never had reason to regret our expectant policy; but lately we have been struck by a remarkable series of cases, about six in number, all wounded on or about the apex of the temporal crest. These patients have come in but little affected, often showing no physical signs, or, at most, a slight facial weakness, paresis of one arm, or some aphasia. Their temperature and general condition on admission have given no cause for anxiety. They have remained well for two or three days, at the end of which time signs of cerebral mischief have suddenly revealed themselves. Fits unamenable to bromide or morphia, increasing optic neuritis, severe headache progressing to drowsiness, with progression of focal symptoms, have all indicated urgent need for operation. On turning down a flap, at most a slight cracking of the temporal bone has been seen; more commonly there has been a considerable area of discoloration, a bluish appearance of the bone under the wound; in one case there was no change in the bone at all. There has been no extensive extradural hæmorrhage, but the dura has appeared discoloured and unhealthy. Underlying the dura, which was in most cases adherent to the subjacent brain by a layer of altered clot, a considerable cavity containing pulped brain and sanguineous material has been found in the temporal lobe. Evacuation of this collection, with drainage, has caused a gradual amelioration of symptoms, and our mortality for the six cases has been nil. The following case is typical of this class :—

Case 2.—Pte. J. was admitted to hospital on August 9th, 1916, suffering from a superficial gutter-wound in the region of the left temporal ridge. He stated that he was wearing a helmet when wounded. He was quite fit and intelligent on admission, but had some slight sensory aphasia. His temperature was normal. X-ray examination was entirely negative. He remained well until August 11th, when he had a Jacksonian attack, limited to the right side of his face. He also developed weakness of the right side of his face and his right arm during the day, and one fit followed another at rapidly decreasing intervals. His optic discs showed two dioptres of swelling.

Operation was performed on August 11th. A large flap including the wound was turned down, and it was then found that the wound was literally only skin-deep, and the underlying fascia had not been penetrated. No injury to the bone was seen. A trephine disc was removed under the wound near the apex of the temporal ridge, and a large area of bone nibbled away with forceps. The underlying dura was tense and discoloured, but had not been penetrated. A small dural flap was turned down. On incising the flap the underlying cortex was found firmly adherent to it, with a thin film of altered, adherent, sticky blood intervening. Underneath was a considerable cavity in the temporal lobe, containing much disintegrated brain substance mixed with sanguineous purulent material. This was evacuated, and the cavity drained through the scalp wound by a rubber tube. The following day the patient was very ill and collapsed, and had several fits, but after that he steadily improved, and has since gone home.

It has seemed to us from a study of the above series of cases that this phenomenon is due to a "whipping" of the temporal bone, which, unlike the other components of the skull cap, is unprovided with a diploic splint. Consequently considerable damage may be done to the underlying brain, although no fracture is revealed. An important causative agent is also probably the fact that the buffers in the lining of the helmet are in close contact with the head in this region. In other regions where no fracture is shown we have had no such difficulties.

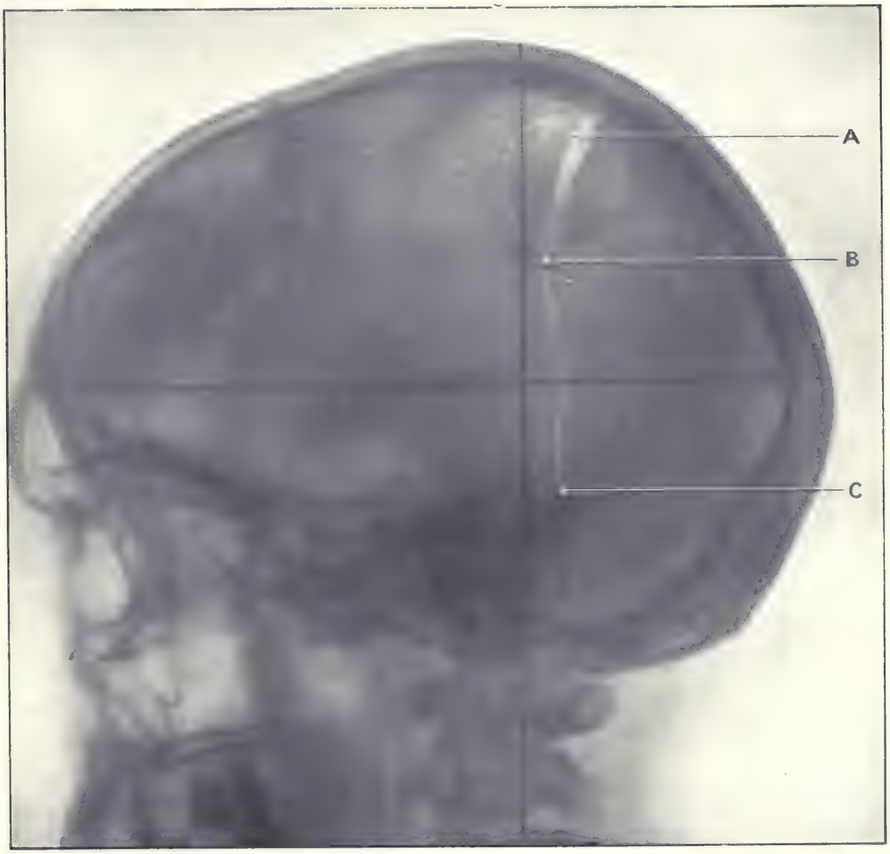

Fig. 3. Gutter fracture, with limited depression of the inner table and with extensive fissured fracture extending to the base. **A.** The light area is the actual outline caused by the wound in the scalp. **B.** Dark circular lines mark the depressed inner table, which does not penetrate the dura. **C.** Fracture, which can be followed stereoscopically as far as the foramen magnum.

2. *A small bone crack, usually limited in extent, with no sign of in-driven fragments.*—These cases we generally left alone, as it is difficult to see what can be gained by operative interference.

3. *Extensive fissured fractures without depression.*—These are often serious, running down to and involving the base of the skull. We usually left them alone unless urgent symptoms manifested themselves. It is important to note that the dura is frequently nipped up in the fissure, and may be much damaged at the time of operation unless the fact be borne in mind. Fractures of this nature are generally due to the impact of a large blunt object, such as a big shell fragment or nose cap, on the skull. We believe that skulls showing extensive fissured fracturing have increased in relative proportion to the other types of wounds since the introduction of the steel helmets.

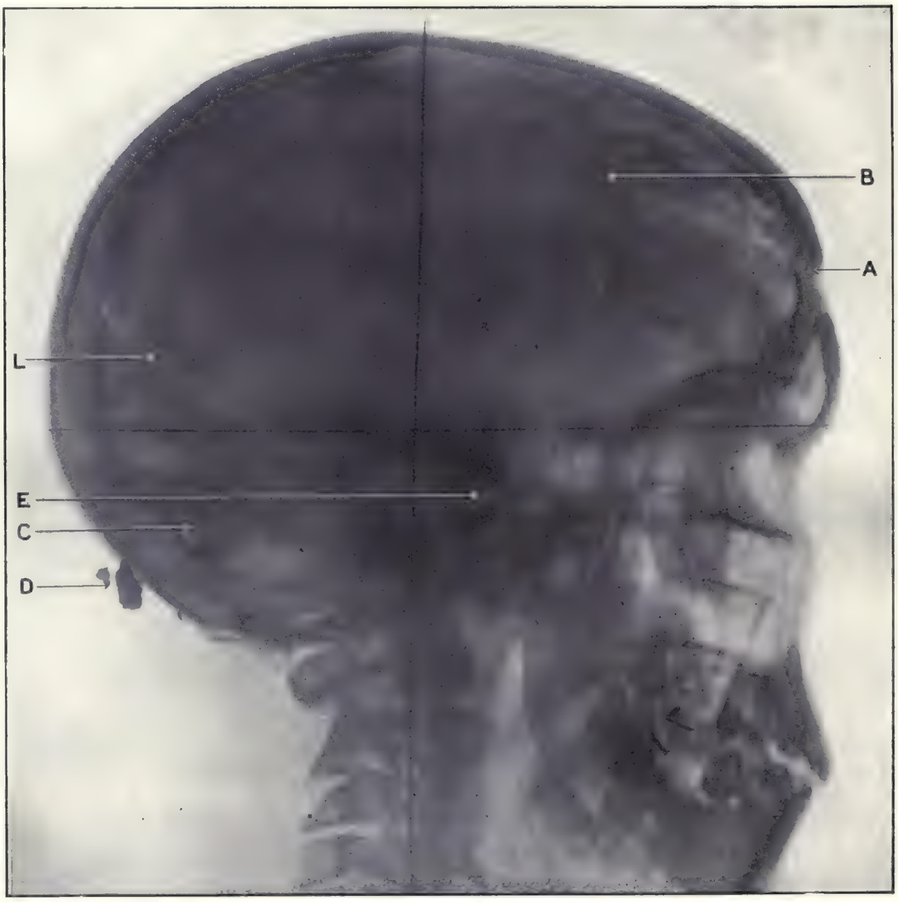

Fig. 4. *Position* 1. The lobulations of the brain are visible, especially in the frontal convolutions. Two large defects in the skull are shown, caused by multiple wounds. A. Depression to the right of the middle anterior frontal. Metal in scalp; no metal in brain, but a track passing inwards for 2½ inches; B. Linear fracture passes backward as far as posterior parietal; C. Large depressed fracture to the right and below the torcular; D. Metal in wound entrance; E. External auditory foramen; L. Lambdoid suture resembling a fracture.

4. *Gutter fracture with only limited depression of the inner table.*—The outer table remains more or less in position. The injury in these cases is only shallow, and often it can be safely prophesied that no injury to the dura beyond bruising has occurred. To this class belong the "lid-like" fractures, the two lips of the lid being inverted in a valve-like fashion (Figs. 2 and 3).

We have made it the usual practice to operate for the removal of these depressed fragments, unless the fracture is over the longitudinal sinus.

5. *Gutter fracture with considerable in-driving of the inner table.*—The brain underlying the fracture is penetrated by bone fragments to a greater or less extent. The contour of the outer table is still more or less preserved. In this class we have operated on every case.

6. *Penetrating wounds with no missile in the brain* (Fig. 4).—In this class there is a definite defect involving both tables. Fragments of bone are driven into the brain to varying depths. Such cases almost invariably require operative interference, and generally at the operation a dirty brain-track is found containing bone fragments and pulped septic brain material. The chances of the patient's recovery seem to vary inversely with the length of the track, those communicating directly with the lateral ventricle being very fatal. Penetrating wounds below the tentorium cerebelli are also of bad prognosis (Fig. 5).

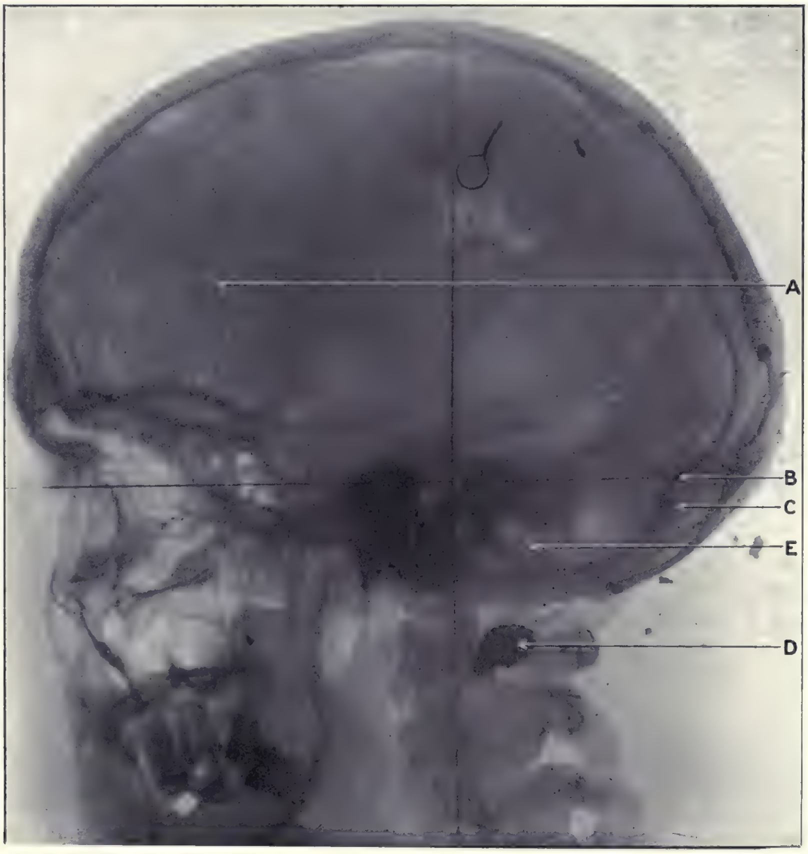

Fig. 5. *Position* 4. Multiple injuries. Ring over wound in left mid-parietal area. Defect in skull, with track passing into brain for a distance of over an inch. A. Fracture passing directly forwards to anterior frontal; B. Large second wound and bony defect in right occipital, just above and to the outer side of the torcular C; D. Large piece of shell, which has passed through the occipital wound, tunnelled the base of the skull, and emerged at the level of the base of mastoid and to its inner side; E. Marks the exit. The lateral sinus was opened up. The lambdoid suture is well seen.

7. *Wounds with one or more missiles retained, either in the bones of the skull or in the brain.*—(*a*) The missile may actually be arrested in the bone.

In some cases the projectile has penetrated the outer table only, leaving the inner table intact. A trephine disc has been removed, comprising the outer table, with the missile firmly stuck into it, leaving the inner table and a great part of the diploe intact. Both tables may be penetrated, a part of the missile lying firmly wedged in the bone. In one case the foreign body, a thin sickle-shaped fragment of helmet an inch in length, had penetrated both tables. Its lower end was driven through the dura for fully a third of an inch, while its upper end just protruded above the outer table.

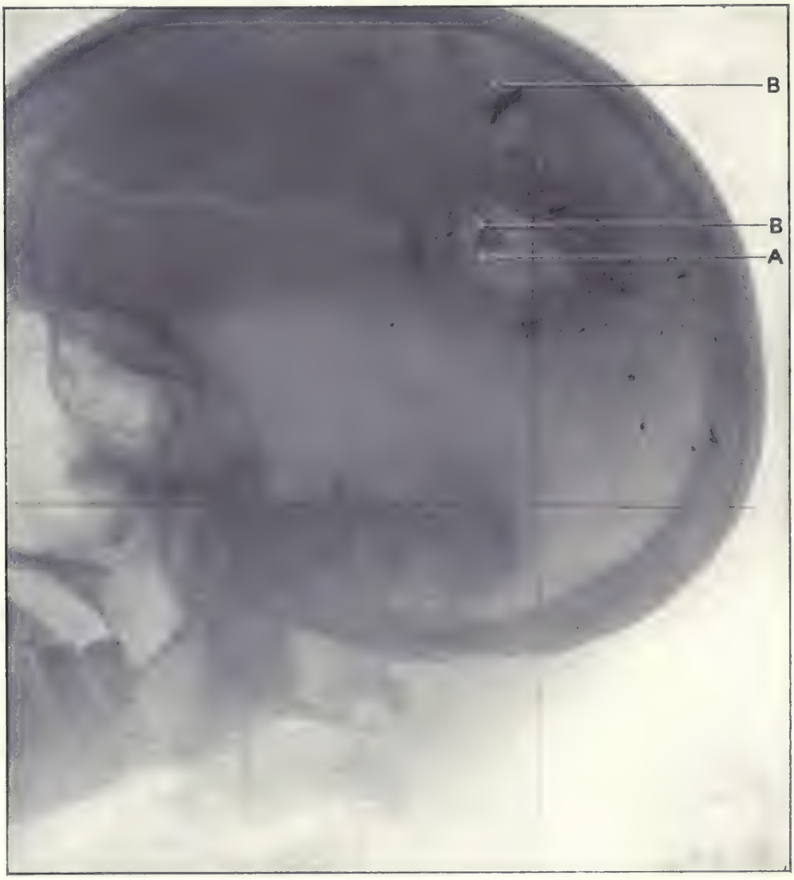

Fig. 6.—*Position* 2. Pte. C., admitted April 19th, 1916, died the same day. **A.** A large circular defect in the right posterior parietal region. Edges of defect are lined by numerous small metal fragments. All the larger fragments are in the wound track crossing the brain almost to the other side of the skull; **B.** Shows the largest fragments, all of which are furthest removed from the wound of entry. Extensive fissured fractures extend horizontally forwards to the frontal region and backwards to the upper occipital.

(*b*) The missile may have passed entirely through both tables of the skull, and be lying between the inner surface of the skull and the dura, the dura still being intact.

We have had a number of cases of this variety, and have operated on every one, with no mortality. In certain cases the missile has penetrated the dura and has sprung back, lying between it and the inner aspect of the skull. In several cases in which this has happened the brain has become infected underneath, and the missile has been found at the operation to have formed the cork to a large brain abscess.

(*c*) One or more missiles may be lying in the brain substance at varying depths from the wound of entry.

The missile usually forms the base of a cone, the apex of which is at the wound of entry into the brain. This cone is made up of pulped brain tissue and bone fragments of varying sizes. In those cases where the missile is made of lead, say a shrapnel ball, small shreds of the outer covering of the ball are shed along the track, and may be seen as glistening white specks (Fig. 7). As a result of this "moulting" process, the ball itself may be very much misshapen. It is interesting to note that the larger bone fragments lie at a greater distance from the wound of entry, and consequently nearer the missile, than do the smaller, and it is quite the exception to find any of these at a greater depth than the missile. Often, if one of the larger of these bony

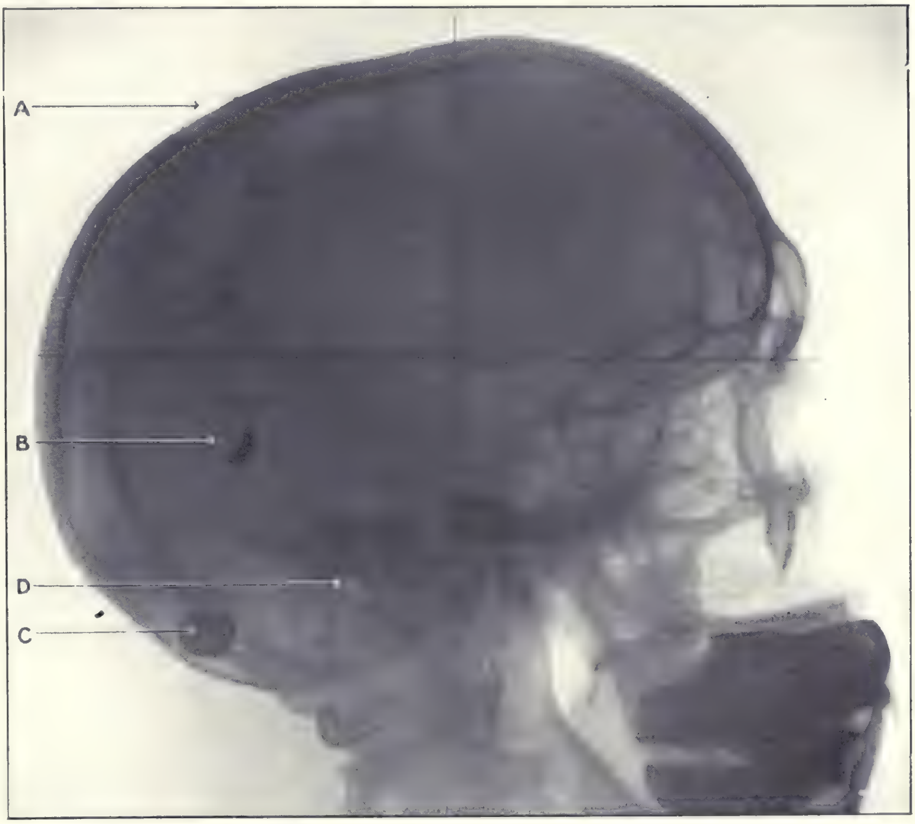

Fig. 7.—*Position* 4. **A.** Wound of entry of shrapnel ball just to the left of the vertex, where some small metallic fragments may be seen lying in the scalp ; **B.** Downward track showing lead shavings in the brain ; **C.** A large misshapen ball lying in the left cerebral hemisphere ; **D.** Auditory meatus.

fragments be lying turned on edge, the shadow cast by it approximates to that cast by a small piece of metal, and it may be difficult to determine which of the two it is. The importance of determining whether any missile be of lead or some other metal is apparent when the question of its possible removal by a magnetic rod comes to be discussed. (See Figs. 6 and 7.)

We have come across several instances where the missile had penetrated the brain, and lay on or near the bone on the opposite side of the cranium. The foreign body retained is generally a large piece of iron casing; in some instances fractures of the bone were found near the position of the foreign body, showing the position where the missile had struck the bone, but its momentum was not sufficiently great for it to penetrate and pass onwards.

Various Types of Missiles met with.—In the early days, during the first and second battles of Ypres, we passed through a phase when many shrapnel balls were retained in the skull, our record case being one in which five such balls were embedded in one brain; but lately, since the almost universal adoption of high-explosive shells, these have been seen but rarely.

Rifle bullets are comparatively seldom seen, but during the past year we have had several such cases. The wound of entry caused by a rifle bullet is often small and easily missed, and commonly no bone defect can be felt. The patient is often surprisingly well, and in at least one case it was only by chance that an X-ray photograph came to be taken.

Case 3 (Fig. 8).—Gunner C. was admitted into hospital on July 1st, 1916. He was wounded on the night of June 30th. There was a fight between two aeroplanes going on overhead. He was wearing no helmet, and thought that he had been struck by a shell fragment from an anti-aircraft gun. He had a tiny wound of the vertex 5 inches behind the nasion (nasion to inion 14 inches) and ¾ inch to the right of the mid-line. There was some œdema around the wound. X rays showed a small opening in the skull under the wound of entry, with a brain-track passing down to the base of the skull, where lay a rifle bullet behind the right orbit. The apex of the bullet was sticking into the hard palate. Beyond a slight frontal headache and some drowsiness on admission he had no physical signs, and was evacuated to England on July 14th, no operation having been performed.

Nowadays shell fragments form by far the greatest proportion of missiles; commonly there are one or two, but in some cases, mostly hopeless, we have seen dozens of such fragments embedded in the brain (see Fig. 6).

Operative Treatment.—Whilst tempted, in the early days, to operate on every case, and attempt removal of the missile if not too hopelessly inaccessible, lately we have adopted much more expectant treatment. If the missile be deep and the wound of entry clean, we have left it untouched unless urgent symptoms arise. The following is a good example of the small amount of damage that a number of missiles embedded in the brain may do.

Case 4.—Pte. T. was admitted to this hospital on June 17th, 1916, suffering from a grazed wound of the frontal region, evidently only superficial. He gave a history of having been wounded the previous March by a rifle grenade at the back of the head. This wound must have caused him little trouble, for he was back with his regiment nine days later. After rejoining he noticed a difficulty in controlling himself, becoming easily excited when in the fire trenches. He had been discharged from the army in 1906 for insanity, and was put into a lunatic asylum for some time by his own people. He also had a bad family history of insanity. It is not to be wondered at, therefore, that he became excited while under fire, and his wound probably had little to do with the condition. He was also gassed on April 29th, but not sufficiently badly to leave his unit.

Examination of his head revealed the recent graze over the frontal region, and a tiny, perfectly healed wound of the occipital region 1 inch above and 3 inches to the right of the inion. X rays showed no fracture under the recent frontal wound, but a small defect of the occipital bone under the old wound, with a shell fragment and many small pieces of bone embedded in the right occipital lobe. He seemed normal in every way, and showed no sign of intracranial injury. He was evacuated to England on June 20th, apparently quite well.

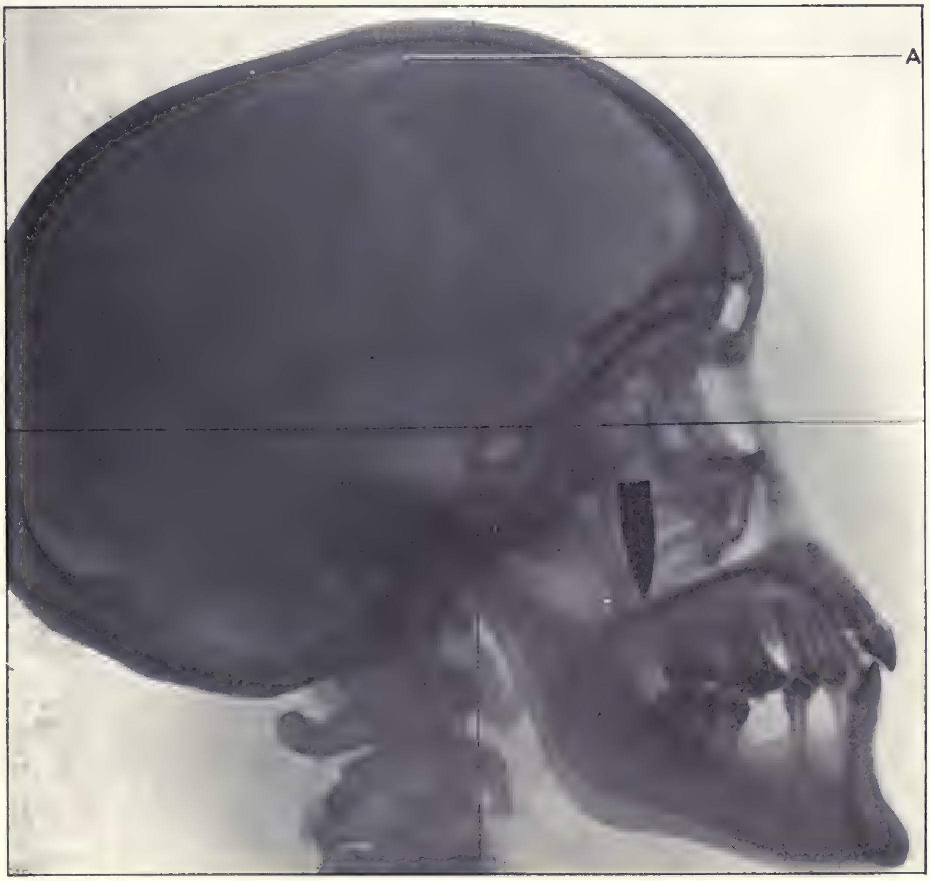

Fig. 8.—*Position* 1. Gunner C. (*Case* 3.) A. Marks a tiny perforation of the skull near the vertex. From this a bullet has passed through the brain and the base of the skull just behind the right orbit, and is lying with the apex embedded in the hard palate. The track of the bullet is very faintly shown.

When the wound of entry is septic, and especially if pulped brain be oozing from it, operative interference of some sort is imperative. Where the foreign body is inaccessible, two inches or more from the opening in the dura, it has been found advisable to do nothing more than clean up the wound of entry, removing the superficial in-driven bone fragments, and if the track be not too hopelessly septic, drain by lateral rubber tubes placed in at the angles of the flap after excision and suture of the excised edges of the wound of entry. We have resorted to direct drainage of the track through the wound of entry for the most part only when we have judged it to be very septic.

In one extraordinary case (Case 5) we were able to show by X rays a brain-track giving a peculiar wavy appearance, due, as autopsy subsequently revealed, to a gross infection of the track with gas-forming bacilli.

Case 5.—Pte. R. was admitted to hospital on May 22nd, 1916, suffering from a wound received on May 17th. He brought a note down with him from the casualty clearing station saying that a decompression operation had been performed around the wound of entry on May 19th. He had a deep gaping elliptical wound, 11½ inches behind the nasion (nasion to inion 13 inches) and 2½ inches to the left of the mid-line. The brain was exposed at the bottom of the wound.

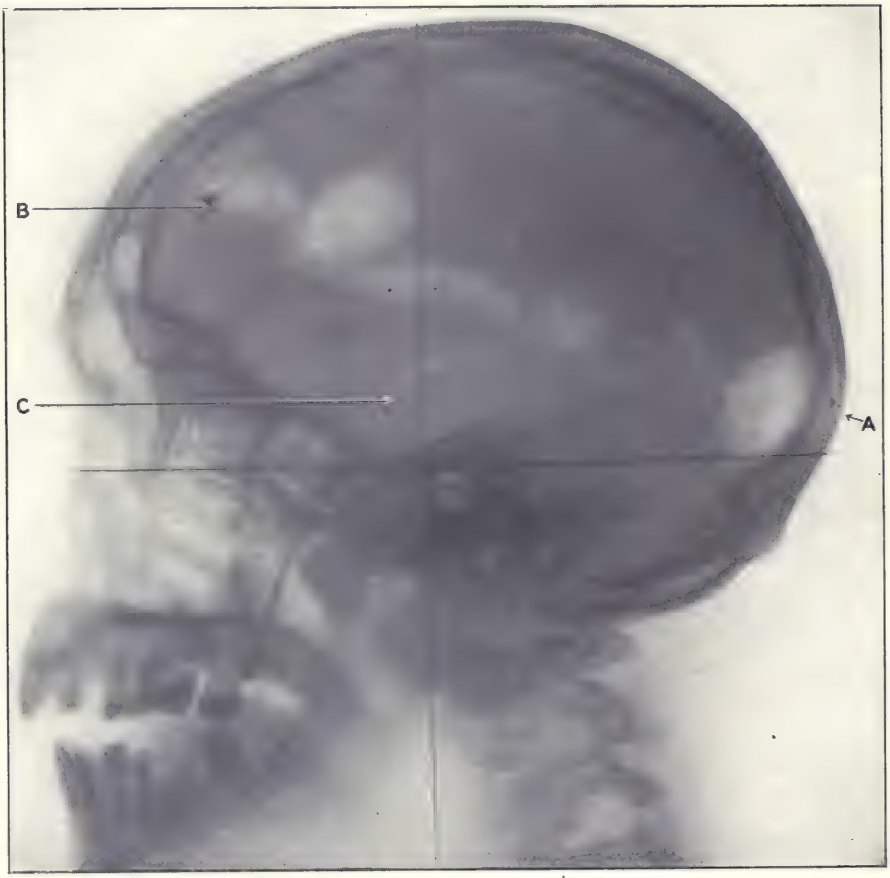

Fig. 9. *Position* 1. (*Case* 5.) Wound track through brain distended by infection with gas-forming organisms. **A.** Point of entrance; **B.** Small fragment of shell lying in end of track underneath pia mater. The large main track runs directly through the left cerebral hemisphere, and is much larger than the entering missile. Its wavy appearance is caused by side pockets of gas contained in tracks which pass laterally; **C.** A tiny fragment slightly above the pituitary gland lying at the end of a track which passes in a crescent direction downwards and forwards from about the middle of the main track. The patient survived for five days after this radiogram was taken.

X-ray examination (Fig. 9) revealed a large bone defect in the left occipital region, with a small shell fragment just inside the opening. From this an extensive wavy track passed forward to the frontal region, where lay a shell fragment small out of all proportion to the very large track along which it had passed. From the centre of the main track a subsidiary track passed downward, forward, and inward, terminating in the region of the pituitary fossa, where there lay another small fragment of metal. A tentative diagnosis of gas-gangrene infection of the track was made, to account for this unusual appearance. The patient was comatose on admission, and died a week later. Autopsy revealed a very extensive brain-track, showing obvious gas-gangrene infection, passing forward in a manner shown in the radiograph.

8. *Perforating wounds, with entry and exit wounds present in the skull.* (Fig. 5).—Wounds of this type have been comparatively rare, especially since the universal adoption of the helmet by our troops, but a certain number have passed through our hands.

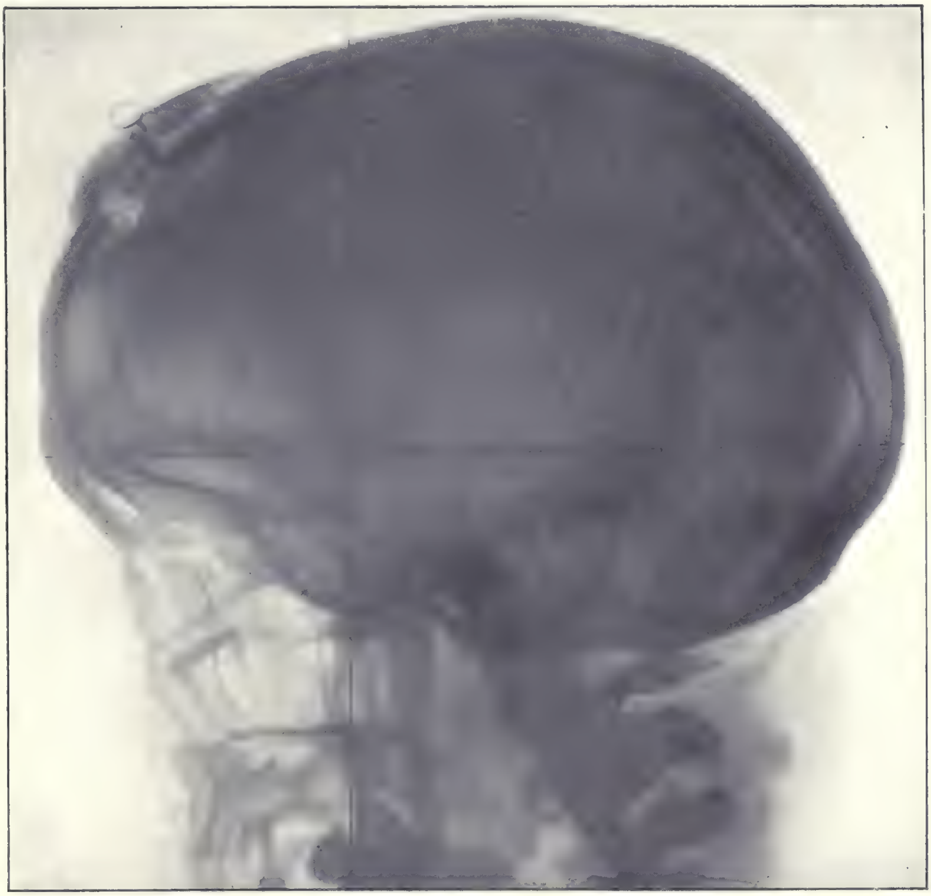

Fig. 10. *Position* 1. (*Case* 6.) Perforating wound of frontal region, showing large "expressed" fragments of frontal bone, comprising both tables, between the wounds of exit and entry. The ring marks wound of entry.

Biparietal perforating wounds, usually caused by a rifle bullet, have perhaps been the most common examples of this type, and often in the cases that arrive here, surprisingly little damage appears to have been done to the bone or brain. In one case, Pte. M., a detailed report of which has already been published,* a shrapnel ball had passed through the brain from one parietal region to the other, and was found by X rays to be lying between the temporal muscles and the bone on the side opposite to that by which it had entered. Beyond slight apraxic symptoms the patient seemed little the worse for his injury, and was able to walk a few weeks later. We have heard with regret that this patient has since died after a secondary operation for removal of bone fragments.

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* SMITH AND HOLMES, "A Case of Bilateral Motor Apraxia with Disturbance of Visual Orientation," *Brit. Med. Jour.*, 1916, March 25.

Perforating wounds of the frontal region have usually been very severe, the frontal bone being very extensively fractured and broken up, with great destruction of the underlying frontal lobes.

Case 6.—Pte. A. was admitted on Aug. 22nd, 1916, suffering from a rifle-bullet wound of the frontal region received on Aug. 16. He was wearing a helmet, and the bullet must have traversed the helmet. He was unconscious for a time, but recovered sufficiently to walk from the trench where he was wounded to the dressing station. The wounds of exit and entry are well shown in the figure. There was much bruising and discoloration over the whole area included between and surrounding these two wounds, and the whole scalp appeared uplifted in this region, giving the patient an appearance uncommonly like that presented by a case of congenital "tower-skull." There was also much bruising and discoloration around both eyes, but no proptosis.

X rays (Fig. 10) showed a large plate of the frontal bone uplifted between the wounds of entry and exit; from this a linear fracture passed back to the region of the right coronal suture. There were no bone fragments driven into the brain. His only symptoms were some drowsiness and severe frontal headache. During the first few days after admission his condition gave rise to anxiety, and the bruising and discoloration increased to an extent we had not hitherto seen. After the first week, however, he improved, the bruising subsided, and an X-ray photograph taken just before discharge to England on Sept. 8th, showed the displaced plate of the frontal bone beginning to drop into position again.

Although great bruising around the eyes, indicating a fracture into the anterior fossa, has always been common in frontal injuries, it is only lately, since the introduction of the helmet, that cases showing severe mottling of the scalp, usually of a purplish tinge, have appeared. In the above case it was probably due to squeezing of the scalp tissues between the uplifted bone and the under surface of the non-yielding helmet.

Perforating wounds of the occipital region have been rarely seen, doubtless on account of their early fatality.

SOME MODERN DEVELOPMENTS IN ROENTGENOLOGY.*

By L. Erasmus Ellis, M.D.

Mr. President and Gentlemen,

An address by a member of one profession to members of another profession is usually accompanied by a number of technical difficulties, but when I had the honour of being asked to read this paper before your Society, I recognised that in radiography both the electrical and the medical professions have a subject of common interest. Whereas, however, the exponents of electricity are responsible for the production of X rays, so those of medicine have to assume the onus of its application. While, therefore, endeavouring not to be too technical in my own especial branch of this work, I crave your indulgence for any shortcomings I may exhibit in your own very important portion of the subject.

In considering radiography, one naturally thinks first of the different methods adopted for the generation of X rays. Without entering into a general history of Roentgenology, I will briefly mention some of the most important types of apparatus used in the modern production of the Roentgen ray.

The time-honoured coil and break still holds its own, either in its original form, or with some modification to improve the quality of the rays produced. The main defect in this apparatus is the production of inverse current, and it is to the suppression of this that the inventor's energy is mainly directed. Amongst the different modifications of the coil and break apparatus, I may mention one invented by my one-time preceptor in the art of radiography, Dr. Reginald Morton. Its object is to suppress inverse current and dispense with valve tubes and other devices, which for long have been the only means whereby we, very inefficiently, attempted to combat this evil. Inverse current seriously hampers the radiographer by blurring his picture and detracting from the efficiency of the rays produced, while it materially shortens the life of the tube used. While, however, Morton's apparatus is satisfactory for moderately heavy currents, up to about 10 ampères, it does not answer so well when really heavy discharges are required.

A sounder treatment of inverse current, however, is to utilise it instead of suppressing it. Under this system the strength of the current offers no difficulty, while instead of the inverse current being a disadvantage, it is actually requisitioned to reinforce the desired effect upon the X-ray tube. An apparatus embodying this principle has recently been invented. It consists firstly of a powerful coil wound with two distinct primaries and having a common central terminal. A two-jet mercury break is included in the circuit, and to the shaft of this break a commutating disc, similar to that used on the high-tension transformer outfit, is attached. This makes the impulses arising from the inverse current, *i.e.*, the current generated at "make," unidirectional with the main current generated at "break." (ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY, 1917, p. 149.)

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* **Being a paper read before the South African Institute of Electrical Engineers, Johannesburg, 21st June, 1917.**

A modern type of apparatus, however, which is very popular, is the high-tension rectifier or transformer. There are a number of different patterns of this machine, all established on the same main principle, with their own individual modifications. One of the earliest makes was the "Snook" apparatus, which was introduced into England from America some years ago. The system upon which the high-tension rectifier works is the generation of an alternating current, which is stepped up from a comparatively low voltage to a tension of about 120,000 volts, by passing through a transformer heavily insulated and often immersed in oil. The high-tension alternating current is then made unidirectional by a mechanical device run in synchronism with the alternating current, which takes the lower curve of the sinusoidal current, and places it on the same line as the upper curve. In this apparatus inverse current is non-existent, and the light from the X-ray tube is, under ideal conditions, almost without a flicker, which is in marked contrast to the unsteady light often generated by a coil and break. The skiagrams that you will presently have an opportunity of seeing are taken with this type of apparatus, and you will be able to judge of its possibilities and also of its shortcomings.

In comparing the ordinary coil and break with the high-tension transformer, one has to acknowledge that each type of apparatus has its advantages and drawbacks. The former system of current generation, as I have already mentioned, has the disadvantage of the presence of inverse current, while mechanical trouble with the different kinds of breaks invariably occurs. The break portion of this type of outfit appears still to be unsatisfactory, but great advances have in recent years been made in the construction of heavy discharge coils. The high-tension transformer, while obviating both these difficulties, suffers from a lack of penetrating quality in the X rays produced. The curve of the high-tension current lacks the peak that is present in the wave of a current from a coil and break apparatus, and it is the upper portion of the curve, or the actual peak itself, that possesses the most penetrating qualities. With these disabilities present, there remains much scope for improvement, on the electrical side, in the production of X rays.

The subject of the generation of the Roentgen ray would be quite incomplete if some details were not given about the modern types of X-ray tubes. The general principles of the Crooke's tube are doubtless familiar to you all, how that the high-tension current enters the tube at the anode, passes through a rarefied atmosphere, more or less approaching a vacuum, to the cathode, is projected from the concave surface of this pole on to the target of the anticathode, at which spot the X rays are actually generated. Two of the greatest difficulties that harassed the tube-maker for years past were, firstly, obtaining a metal that would stand the fierce electrical bombardment taking place at the anticathode, and secondly, regulating the rarefication of the tube, commonly called its "vacuum." Platinum has for some years been used to make the target of the anticathode, but tungsten and iridium (principally tungsten) are now largely taking its place, and as they stand the bombardment better, they enable makers to so construct their tubes that they produce a better quality of rays. The tendency of a tube in use is to become hard, that is, the rarefication of the interior of the tube increases till it reaches a point at which the current refuses to pass and the tube becomes useless. Several devices have been in common use for the reduction of the vacuum inside the tube, the principal ones being:—(1) the automatic electrical regulator; (2) the osmo-regulator; and (3) the air-valve regulator, as fitted in the Bauer tube. Time will not permit me to describe these in detail, suffice it to say that they all work fairly well, but all have their limitations.

A new type of tube, however, has comparatively recently emanated from America in the form of the Coolidge tube. This pattern consists of a bulb with a very high vacuum within, so high, in fact, that the current for generating X rays will not pass through it. To render the tube conductive, the cathode is provided with a tungsten filament wound in spiral form, which is rendered incandescent by means of a local circuit from a ten-volt accumulator. This spiral is placed in a conical tube so as to direct the cathodal stream to its focus on the anticathode. Until the tungsten spiral is heated to incandescence no current will pass, as already mentioned, and the amount of current that can be passed through the tube will depend directly upon the current passing in the local circuit. It will thus be seen that this type of tube is very adjustable. The Coolidge tube is capable of producing X rays of intense penetration, in fact experiments prove that a full Sabouraud's pastille dose, known as tint B, or 10 X, which is the limit of safety for local application, can be administered through six inches of beef in about fifteen seconds. In addition to emitting this immensely powerful discharge, however, this tube does not fluoresce when it becomes active, and nothing in its appearance indicates that X rays are emanating from it. These facts show that great caution should be exercised in the use of the Coolidge tube, for accidents are much more liable to occur with it than with the older type of tube. It has, however, undoubtedly very great advantages over the latter, mainly in its adjustability, its durability and its penetrating qualities.

Having briefly touched upon a few mechanical and physical facts in connection with X rays, one naturally turns to their medical and surgical application. We use X rays principally in two ways, therapeutically and radiographically. With the advent of the more powerful apparatus and the system of filtering off the soft rays, we have been able to apply therapeutic X rays to a large number of diseases, deep-seated as well as superficial. In dermatology this form of treatment is invaluable. How it acts in many instances is still uncertain, but the fact remains that obstinate skin affections, which have been very intractable under ordinary treatment, improve or entirely clear up under X-ray applications. Deep-seated growths, principally of an innocent nature, also improve and sometimes completely disappear under heavy doses of hard, filtered X rays. The great danger that one has to guard against is the setting up of a dermatitis, but the use of hard rays and effective filters obviates this to a large extent. Of the rays emanating from an active X-ray tube, the alpha, beta and gamma rays are those most usually spoken of. There are other rays both in direct sequence to these and also adventitious rays, which apparently play a minor part. Of those mentioned the alpha and early beta rays are the ones most detrimental to the skin, and at the same time least beneficial therapeutically. They can, however, be cut off by filters made of different materials, the most popular probably being some two to three millimetres of aluminium, flanked on either side with about half a dozen sheets of ordinary chemical filter paper, the office of the latter being to absorb the various adventitious and secondary rays that are generated in and around the active tube and possibly from the metallic portion of the filter itself. Another method of avoiding damage to the skin, in the treatment of deep-seated growths, is to apply the doses of X rays through different ports of entry, subjecting the tumour to a cross-fire application from different sides. Thus it is possible to administer huge doses of X rays to deep-seated disease without damage to the superficial structures, and much success has been obtained by so doing.

(To be Continued.)

REPORTS OF SOCIETIES.

ROYAL SOCIETY OF MEDICINE.

SECTION OF ELECTRO-THERAPEUTICS.

(October 19, 1917.)

PRESIDENT'S ADDRESS.

The Necessity for Education in Radiology and Electro-Therapeutics.

By G. HARRISON ORTON, M.D.

(Reprinted from the "Proceedings of the Royal Society of Medicine," Vol. XI, No. 1.)

THE status, in this country, of radiology and electro-therapeutics and of those who specialize in these subjects is not satisfactory. I am not the first to touch upon this, for Captain Thurstan Holland, in his presidential address before the Röntgen Society last November, showed, with many illuminating examples, with which most of us are unfortunately too familiar, what a detrimental effect this war is having on these branches of medical science and on those who practise them. No good will be done by reiterating example upon example, to show the dangers of allowing the present system, or rather lack of system, to exist, but I would strongly advise those who have not read Captain Holland's address to do so, and need only add that the present state of things is unfair to the patient, who is often the chief sufferer, and unfair to the radiologist and electro-therapeutist. There can be no doubt but that this state of injustice, this hopeless lack of system, is due to defective education, and therefore I think it necessary, that before we can expect any improvement to take place, some scheme of education must be devised.

That education is very necessary, even among prominent members of the medical profession, the unsatisfactory conditions existing in the X-ray departments of many military hospitals are alone sufficient to show. In the *British Medical Journal* of September 15, 1917, Captain Thurstan Holland published a letter which I will quote.

> I have before me the July number of the *American Journal of Roentgenology.* It contains a statement on the action of the U.S.A. military authorities in the organization of X-ray work for army purposes. As this is in such striking contrast to the methods adopted in this country, I venture to call your attention to it.
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> On June 11, the Surgeon-General convened a meeting of prominent radiologists with some of his medical officers. This conference sat in session for two weeks. As a result—
>
> (1) A number of schools for the teaching of military radiographic work were established in charge of experts in different parts of the country, and were directly controlled by the Surgeon-General.
>
> (2) Medical officers intending to do X-ray work have to attend for three months' instruction, and then are accepted or declined according to the ability shown.
>
> (3) Arrangements for the X-ray examination of recruits—especially from the point of view of the condition of the chest—were made.
>
> (4) The numerous methods for the localization of foreign bodies were considered, and it was decided that three methods should be taught thoroughly, and only these three.
>
> The Government is defraying the expense of this organization and teaching, and officers taking the course of instruction draw, during this period, the pay of their respective ranks.
>
> This action of the American authorities in their recognition of the importance of expert medical men controlling the radiographic work shows great foresight.

Now in this country I think I am right in saying that practically the whole of the organization of military X-ray work has been carried out without any consultation with prominent radiologists, with possibly one exception. Why is this? Evidently the failure of the authorities to recognize either radiology as an important branch of medical science or the radiologist as a specialist, again evidence of ignorance due to lack of education in this subject.

What I have said with regard to radiology appertains with perhaps even more force to electro-therapeutics, and it seems to be the opinion of those in authority that any person capable of switching on an electric current is quite well enough qualified to carry out electrical treatment. We are all familiar with the touching little photographs in the lay press—the small faradic coil, the possibly fascinating V.A.D. gently stroking the muscles of the wounded hero, while watching in the background is the generous donor of the apparatus, a pretty picture, but surely one not likely to elevate the status of electro-therapeutics or of the electro-therapeutist. Recognizing then that all this is due to ignorance and lack of education, I propose now to outline as briefly as possible certain efforts which have been made, since last March, to put these branches of medical science on a satisfactory footing, and to raise the radiologist from the ignominious position in which he finds himself.

At the Council Meeting of this Section, held on March 16 of this year, a letter was brought forward by Sir James Mackenzie Davidson dealing with grievances which a radiologist had against certain of the military authorities. The Council was of opinion that the radiologist in question had not been fairly treated, but regretted that they, as the Council of the Section, were not able to take any action in the matter. This however led to an informal discussion, the upshot of which was this: A small committee was formed, with Sir James Mackenzie Davidson as chairman, to do what was in its power to counteract the bad influences at work, and try to improve the status of the branches of medical science in question.

The first meeting of the committee was held at Sir James Mackenzie Davidson's house on April 4 of this year, and the points discussed were:—

(*a*) The best manner in which to deal with questions concerning the status of medical men holding positions as radiologists and electro-therapeutics.

(*b*) The steps to be taken for the promotion of the teaching of radiology and electro-therapeutics.

Many suggestions and schemes were thoroughly discussed, and a small sub-committee was formed to deal with the matter, the upshot of this being that a letter, of which the following is the text, was sent to the Vice-Chancellor of Cambridge University on May 26, 1917 :—

The call for some organization of the members of the medical profession who practise radiology and other branches of electro-therapeutics is urgent, and there is great need that some steps should be taken to establish these subjects on a proper footing both in regard to the public and the profession generally. At present no standard exists : there is no organized teaching of the subjects, and those medical men who have taken up this branch of medicine have had to pick up their knowledge almost entirely by experience—at the expense of their patients. The result of this haphazard state of things is well depicted by Captain Thurstan Holland in his Presidential Address before the Röntgen Society. The lack of knowledge on the part of those who have been responsible for placing totally untrained men, both lay and medical, in charge of most of the military X-ray departments has led to endless tragedies, while in civil practice much suffering would be saved if competent radiologists were in charge of the departments. In civil general hospitals, where the X-ray department is properly organized, fully 10 per cent. of all the patients who enter the doors of the hospital find their way to this department, and this in spite of the fact that those in charge are so over-burdened with routine work that there is no time for research or the undertaking of new branches of diagnosis and treatment.

As the outcome of a discussion at the Council Meeting of the Electro-Therapeutic Section of the Royal Society of Medicine on March 16 of this year, a small committee was formed to consider :—

(i) The best means of raising the status of radiology and electro-therapeutics to their rightful place among the branches of medicine, and to attract the better class of medical men to take up these special subjects.

(ii) To suggest what steps should be taken to provide teaching in radiology and electro-therapeutics.

At this meeting, after a prolonged discussion, a sub-committee was elected to go into this matter.

After considering several schemes the sub-committee suggested that it was not advisable to start any programme of teaching in London until it was known if facilities could be offered for granting a Diploma at Cambridge, or some other University.

It was decided to approach Cambridge University in the matter, as it was stated by one of the members that funds would be found not only to provide for the necessary expenses, but also to equip, maintain and eventually to endow a Research Hospital and Chair if these facilities were granted by this University.

It is intended that the scheme shall be started on broad lines, in order that development may not be hampered ; the objects being :—

(i) To provide a standard in these subjects.

(ii) To provide the teaching that will be necessary, together with the facilities for hospital experience.

So far as it has advanced at present the scheme of the sub-committee provides for :—

(A) A central organization in London, housed in an institute, where teaching facilities would be available in the scientific part of the curriculum, the practical experience being available in the large hospitals. Later, if necessary, centres could be started in other towns.

(B) A post-graduate diploma in one of the older universities, where a research hospital would be built. This hospital would be devoted to the scientific investigation of the many physiological, pathological and physical problems that are waiting to be worked out. This hospital would be available for those who wished to work on various problems and especially for those who were investigating with a view to the M.D. thesis.

Appended you will find outlines of :—

(A) The London Scheme.

(B) The Cambridge Scheme.

(A) The London Scheme.

A representative board, elected annually, would be responsible for this scheme.

(1) The intention is to provide a Central Institute in London, equipped for general organization, and also for post-graduate teaching, where the necessary appliances would be available for demonstrations, and where all lectures on scientific subjects could be given.

(2) Arrangements would be made for teaching in physics, chemistry, pathology, and clinical medicine, and for lectures by specially qualified medical men in those branches of radiology in which they had specialized. Special lectures and demonstrations in allied subjects would also be arranged, and whenever distinguished colleagues from abroad visited this country, they would be invited to deliver lectures.

(3) In conjunction with the University which grants the diploma the Board would draw up the general lines of teaching, not only for the London school, but for any other schools that might be formed.

(4) The Board would arrange for students to hold appointments as clinical assistants in the various X-ray and electrical departments that would be available in the London hospitals.

(5) The Board would arrange centres throughout the country in close touch with the Central Institute, where it would be possible to arrange for post-graduate teaching.

(6) The Institute would be the centre for the spread of knowledge of these subjects and of the work done in this country; and if possible the existing X-ray Journal would be utilized as its official organ.

In the future it is probable that many overseas workers will be attracted to this country, and a strong effort should be made to establish an attractive post-graduate school, where the subjects could be taught in a manner worthy of their importance. It is especially important to get the scheme started as soon as possible, even in a small way, for when the war is over there will be many medical men who have done the comparatively mechanical war X-ray work, who will be attracted to the subject and who will welcome the idea.

Lay assistance is necessary in X-ray and electro-therapeutic work, and provision will have to be made later for the training of qualified assistants, to whom a certificate would be granted. The next step would be to approach the General Medical Council on the question of the recognition of radiologists, and the making of it illegal for any other than a qualified member to practise these subjects.

This would at once lead to the raising of the standard and the multiplication of posts of responsibility, which would attract the better type of medical man to the new subjects.

(B) THE SCHEME FOR CAMBRIDGE.

Clinical material for adequate teaching facilities is not available in Cambridge, but, on the other hand, there is quite sufficient for research, and the intention would be that, while London, and possibly other large towns, are the teaching centres, Cambridge should be the examining and research centre.

For this purpose it is necessary that there should be some man in charge in Cambridge who would, in conjunction with the duly appointed Board, make the necessary arrangements for the examinations and undertake the direction of the research hospital.

In the first instance the duty of the man in charge would be to find out what men were at work and what work was being done in the various hospitals throughout the country, and to enlist the active and sympathetic support of all workers, not only in the Central Institute in London, but also to obtain their co-operation in the research work. As far as possible he should also be in touch with the work that is being done abroad, especially in Canada and the States.

There is room for endless research in radiology, not only on the physical side, but also on the human—*e.g.*, in the investigation of the alimentary tract and especially in the action of drugs, etc., etc., and it is proposed that a research hospital should be started with twelve or more beds and certain laboratories attached; this should be placed as close to the Addenbroke Hospital and also to the existing laboratories as can be arranged.

In the first place it would be advisable that this hospital should be started in temporary buildings, as it is impossible to foresee on what lines the hospital would develop.

Another meeting was held on June 15, 1917, when the following encouraging replies to the letter addressed to the Vice-Chancellor of Cambridge University were read.

May 28, 1917. The Vice-Chancellor wrote: "I brought your letter before the Council of the Senate this morning. The proposals contained in the letter were received favourably, and the whole question was referred to a special board for medicine, with the request for an answer to the Council before the end of the term." (Rev. T. C. Fitzpatrick.)

June 7, 1917. From Dr. Laurence Humphry, Secretary of the Special Board for Medicine: "The Special Board for Medicine considered your letter *re* medical radiology and welcomed the proposal. It was unanimously agreed to approve the general principle, and the Board were prepared to recommend that steps be taken to institute a diploma. It was thought advisable that the scientific teaching should, as far as possible, be carried on in Cambridge, and that the appointment should be rather a director or reader and not a professor. The Board appointed a small committee to consider the details, and, if desired, to meet members of your committee to discuss the matter."

The committee further considered that in view of the importance of the questions involved, and of the necessity for unanimity of opinion, it would be a proper step to invite the leading radiologists and electro-therapeutists to attend a meeting, and the secretary was authorized to call a general meeting, when the questions could be discussed in all their bearings.

It was also arranged that the secretary should write to the Deans of the various London schools inviting their co-operation in the scheme.

This has been done, and subject to the consideration of details, most of the Deans have replied approving of the scheme, and there can be no doubt that in the near future it should be possible to arrange for post-graduate teaching at several of these schools.

The general meeting above referred to was held at the Royal Society of Medicine on July 26, when, after much lengthy argument and discussion, the following was proposed and carried unanimously: "That this meeting of medical men practising as radiologists desires to express its approval of the initial steps taken by the gentlemen who have submitted an outline of a scheme, and to thank them heartily for the work they have done, and further, to propose that the gentlemen who have already taken action in the matter should form an executive of a larger committee, representative of all the London and provincial schools."

If such a body had been in existence at the beginning of the war, it would have been in a position to advise the military authorities as to the general organization of radiology and electro-therapeutics, and further to undertake the teaching of men appointed to the various departments, on standard methods. Unfortunately this was not the case, but is it yet too late?

From what I have seen and heard even in the last few weeks, I should say decidedly "No"; others will probably say "No," also, though I fear nothing so simple as saying "No" will help us out of the anomalous position in which we find ourselves. But as Captain Thurstan Holland has truly said: "The time has come to enter a strong protest against the continuance of methods which allow of such anomalies to exist." And I think we are now in a position to enter such a protest. From what has been done there appears no doubt that the Cambridge part of the scheme could soon be in active being, if the necessary financial support can be arranged.

It remains for us to see that the London scheme is put upon a sound basis, so that the two may be able to co-operate in practical teaching and research work. To do this, we must endeavour by every means in our power to establish a central institute in London with facilities for post-graduate teaching on a fairly large scale, in order that men who desire to study these subjects may be able to do so under conditions comparable with those already established in other countries.

The task is not an easy one, and I foresee that there are many obstacles still to be overcome, not the least being the lack of funds. The way, however, has been paved, and if we push on with sufficient energy and determination there is no reason why, in the near future, our efforts should not be crowned with success.

MEETING OF MILITARY RADIOLOGISTS IN FRANCE.

Acting under the instruction of Monsieur le Sous-Secrétaire d'Etat du Service de Santé, arrangements have now been made for monthly meetings of the Military Radiologists under the Chief of each district.

The first such meeting for the Paris district was organised by Monsieur le Médecin-Major **Beclere**, Chief of the Military X-ray Service, and was held in the Instruction Hall of the X-ray Department at the Hôpital Militaire du Val-de-Grace, on the 24th of November last, under the Presidency of Monsieur le Médecin-Inspecteur **Polin**, Director of the Medical Service of the Military Government of Paris.

The meeting was highly successful, the hall being filled and many having to stand, and on account of time Monsieur le Medecin-Major **Beclere** withdrew, against much protest, the presentation of his own paper, postponing its delivery to the next meeting, which will be held on the 22nd of December.

Military radiologists are requested to attend their own district meetings and communicate original papers relative to progress in radiology, either from the standard of technique therapeutic, or diagnostic values. In the order of the day preference is given to military X-ray practice whenever possible.

The order of the day comprised:—

1. Dr. **Bouchacourt**, who made an interesting communication on an ideal plan of a practical military X-ray service, insisting on the desirability of space, of the need of close proximity of the X-ray laboratory and the operating theatre, and the essential necessity of a radio-surgical room.

2. Dr. **Charlier** presented a hand fluorescent screen, about 5 × 8 in size, with a cup-shaped metal protection for the hand, and fitted with a sterilisable aluminium cover replacing the usual back protection to the crystals—certainly a practical addition to equipment.

3. Dr. **Desplats** demonstrated a multiple metallic bell point apparatus for the suppression of reverse current. An interesting discussion followed, introducing the comparative resistance interposed by various types of valves. The operation of the valve exhibits its efficiency.

4. Mr. **Boll** and Dr. **Mallet** contributed an interesting article on the physics of the Coolidge tube. Major **Hickey** of the American Expeditionary Force, who was present, was invited to give his experience of the Coolidge tube in America, and described its use direct from the transformer utilising a Coolidge tube as a valve.

5. Dr. **Aime** explained a modification of the pierced screen localiser.

6. Messrs. **Roch** and **Mottier** exhibited a very ingenious pneumatic switch operating at will the lighting of the room and the X-ray tube alternately.

7. Dr. **Solomon** read a paper of some interest on the localisation of "foreign bodies" in the orbital region.

8. Dr. de **Keating-Hart** exhibited some drawings and lectured on the fluoroscopic observations of pyloric stenosis.

9. Dr. **Archambaud** showed some valuable plates proving the need for repeated radiographic observations of bone lesions of the wounded. Major **Beclere** concurred and extended his compliments to the author.

10. Dr. **Lotsy** pointed out and illustrated very admirably the value of clinical examination by the radiographer to obviate mistaken interpretation. The example was a fractured tibia with loss of substance. The plate showed a fine graduation that appeared to be bone regeneration connecting the ends, but which was actually the shadow formed by dense fibrous tissue that had filled the interspace; its presence was revealed by the scar when the bandage obscuring the condition was subsequently removed. This point has obviously a very wide interpretation and was commented on very favourably by Major **Beclere**.

11. Dr. **Gaignerot** showed some instructive radiographs of a broken bone-graft.

12. Dr. **Bonniot** read a paper on the possibility of estimating the thickness of a "foreign body" by fluoroscopic examination.

13. Mr. H. C. **Gage** presented an antero-posterior and lateral tube and plate carrier to facilitate bedside radiography of fractures in suspension and extension, permitting the securing of the same projection in both the directions. Major **Beclere** extended his compliments for this practical contribution.

As may be judged, the meeting, apart from being very interesting, was extremely profitable, the spirited exchange of views that took place during the various discussions showed very clearly how keenly everyone was absorbed in their work, and under the able direction of Major **Beclere** the value of this timely inauguration cannot be too highly estimated.

REVIEW.

The British Journal of Surgery, Oct., 1917. Bristol: John Wright & Sons, Ltd. —The number for October, 1917, is full of interesting papers, which are copiously illustrated. The production of the illustrations leaves nothing to be desired, the coloured plates are particularly good and lend additional value to the interpretation of the text. The *British Journal of Surgery* is undoubtedly a publication of the highest value, and might quite well be taken as a model for others to work upon. The papers in the present number are of peculiar interest to the radiologist who desires to keep pace with the special aspect of his work and its relationship to clinical and practical surgery.

The opening pages deal with a short biography of John Halle, 1529-1568, a surgeon who endeavoured during the reign of Queen Elizabeth to raise the status of surgery in England and to restrain quacks.

A most important paper by Ernest W. Hey

Groves, on "Methods and results of transplantation of bone in the repair of defects caused by injury or disease." This paper occupies 57 pages of the journal and is copiously illustrated by a number of interesting half tone figures. The first section is devoted to a historical *résumé* of the subject. The author next proceeds to an attempt to reconstruct a narrative of bone growths from the work of the authors quoted. The article is illustrated by a number of experiments conducted with a view to demonstrate the steps in bone grafting.

Next comes a section dealing with "Original experimental observations." Clinical methods: General principles, deals fully with the technique. This paper, together with a list of the author's clinical cases, formed the Jacksonian prize essay for 1917. The paper is in every respect an exhaustive one, and should be read by all who are engaged, even remotely, at the present time in radiographic work.

"An interesting case of osteo-aneurysm," by R. Lawford Knagg, details the clinical history and radiographic evidence of this most interesting condition.

"Gunshot wounds of the kidney and ureter, as seen at the base," by Colonel Andrew Hullerton, C.M.C., A.M.S., deals fully with this important subject. An interesting description is given of the value of X-ray examination in kidney injuries, in which attention is called to the value of stereoscopic radiograms and of localization of foreign bodies. The author acknowledges the value of the work of Mackenzie Davidson, Captain Gamlen, Major Higham Cooper, Major Curtis Webb, and Captain Crymble. The value of a method of reconstruction of the track of the missile is demonstrated, and a method of utilising a cross-section atlas of anatomy is described and illustrated. This is an important development in the practical application of radiography with anatomical studies.

A long paper follows on "A contribution to the pathology of projectile fracture of limb bones," by Major E. K. Martin, R.A.M.C., and Captain G. N. Petrie, R.A.M.C. The various forms of injury are fully described and illustrated by excellent drawings and coloured plates. A perusal of this most interesting paper will well repay the radiologist who is engaged in war work.

Under the heading "Instructive Mistakes: A compensation case, in which the markings of the nutrient canals of the ilium were mistaken for fracture; of interest from an X-ray point of view," by Staff Surgeon A. K. Smith-Shand, R.N. This paper details the history of a case in which these markings were mistaken for a fracture of the ilium. The author's interest being excited by this error, he was led to perform a number of experiments on the dried bone. These are set forth in a number of fine skiagrams of the ilium, showing the canals and the variations in their distribution. Several of these canals have been injected with opaque material to demonstrate the extent of their ramifications. The author summarises as follows:—

"This case is of interest in demonstrating that it is possible to mistake an unusually large nutrient artery in the ilium for a fracture of that bone; further, it brings out the fact that the nutrient arteries of the ilium, whatever their point of entry, invariably converge to a common meeting point, which may be considered the true primary centre of ossification of the bone."

The concluding pages of the journal are occupied by a number of reviews.

The above lines summarise briefly the October number of the *British Journal of Surgery.* It is full of interesting material which must be of great value to all at the present time. The publishers are to be congratulated on turning out regularly a journal which can have no superior and few equals. The letterpress is first class, the illustrations excellent. It must be a source of gratification to all English-reading people that such a production can be turned out under conditions which do not lend themselves to perfect literary or typographical production.

NEW INSTRUMENTS AND TECHNIQUE.

DESCRIPTION AND INSTRUCTIONS FOR TYPE "A" COOLIDGE X-RAY TUBE ($3\frac{3}{4}$in. DIAMETER BULB) FOR FINE FOCUS WORK.

THIS new type of Coolidge tube has a bulb which is one-half the diameter of the standard tube and its length is considerably shorter. The approximate dimensions of this type tube are 18 in. length and $3\frac{3}{4}$ in. bulb diameter.

The chief advantages derived from this small type of tube are as follows :—

(1) It permits a closer approach of the diaphragms to the object to be rayed. This is in some cases desirable.

(2) It permits a closer approach of the focal spot to the object to be rayed. This is in some cases desirable.

(3) It decreases the danger of tube breakage in handling.

The focal spot of the target of this tube is extremely fine and due to this fact, excellent detail can be obtained in fluoroscopy and radiographic work, where large amounts of energy are not required.

On account of the very fine focus of this tube, the amount of energy which can safely be used must be small, and we do not recommend using more than the amounts of energy stated in the table given below :—

Spark	*M.A.*
2 in.	25
3 in.	17
4 in.	12
5 in.	10
6 in.	8

When radiographic work is being done, using the maximum amounts of energy which this tube will stand, we do not recommend over a twenty-second exposure, and we would suggest always starting the exposure with the temperature of the target below a visible red.

If the maximum amounts of energy of this tube are exceeded, it will cause the metal at the focal spot to be melted and volatilized. This metal will condense on the bulb and form a heavy metallic deposit which will render the tube very liable to puncture. This melting may also cause gas to be liberated in the bulb and will cause the tube to operate unsatisfactorily.

Although the amounts of energy that this tube is capable of carrying may seem low, and, at first thought, does not seem capable of doing much radiographic work, it must be borne in mind that on account of the extremely fine focus of this tube, the focal distance can be greatly decreased without sacrificing any of the detail, and of course a decrease of the distance will considerably shorten the necessary exposure or the amounts of energy can be considerably decreased.

This tube is particularly valuable for fluoroscopic work, providing, of course, the above amounts of energy are not exceeded.

This tube is also valuable in dental radiography, as it permits a closer approach to the part being rayed and gives excellent detail on the film.

This type of tube is not recommended for therapeutic work.

NOTES AND ABSTRACTS.

RADIO-DIAGNOSIS.

The Relation of the Pathology of Pulmonary Tuberculosis to the Roentgen Findings.—K. DUNHAM (*American Journal of Roentgenology*, June, 1917, p. 280).—From the results of his researches, Dunham believes that in the vast majority of cases of pulmonary tuberculosis the bacillus enters the air passages with the dust and soot, and is carried into the smaller bronchial subdivisions (beyond the ciliated epithelium) as far as the ductulus alveolaris and the ultimate lobule, and that from there it is taken by the large phagocytes, before it has caused any infection at its point of lodgment, and carried to the lymphoid tissue, which is abundant in this locality.

If the phagocytes and lymphoid tissue are unable to destroy the invader, or if the lymphatics cannot drain the part sufficiently, a tuberculous lesion develops in or near the lymphoid centre which at first is merely an abnormal increase of these lymphoid cells. If the bacilli grow instead of being destroyed, a greater effort on the part of Nature results in the appearance of epithelioid and giant cells. Later on, necrosis, caseation and cavitation follow.

In both the acute and chronic forms the lesion can be traced along the lymphatics of the veins, the arteries and the bronchi, and is spread by these means.

If necrosis occurs and the node softens and breaks into the bronchus, the disease may be very easily spread by aspiration at this secondary stage. Later in the disease the tubercle often breaks into a blood vessel and may be spread by means of the blood current.

The author does not, however, deny that a tuberculous lesion can start in a capillary or another vessel, or within some division of the bronchial tree, but these, he thinks, are not the general way. R. W. A. S.

Marching Fractures.—A. H. PIRIE (*Lancet*, 14th July, 1917, p. 47).—Capt. Howard Pirie draws attention to this fracture, caused by severe prolonged marching. It affects one or more of the 2nd, 3rd or 4th metatarsal bones near the middle or towards the head, and occurs usually without the patient knowing when it actually happened.

The radiographic appearances show abundant callus from movement during walking after fracture has taken place.

R. W. A. S.

The Roentgen Diagnosis of a Pathological Gallbladder.—A. W. GEORGE and R. D. LEONARD (*American Journal of Roentgenology*, July, 1917, p. 321).—Though text books on anatomy locate the gallbladder in a fairly definite and constant position, the authors state it may be found almost anywhere on the right side below the diaphragm. They have seen it lying over the spine in the median line, towards the outer side in the right flank, and even below the crest of the ilium almost in the true pelvis. This may be due to some extent to the fact that a large percentage of gallbladders have a distinct mesentery of their own, which allows considerable latitude in movement.

The size of the roentgen shadow in demonstrable cases varies from that of an olive to that of a grape-fruit, as in cases of hydrops.

The shape of the shadow is, roughly, pear-shaped, the most constant feature being the characteristic curve of the lower pole. The inner edge of the shadow is usually distinct, helping to differentiate between gallbladder and kidney.

As the result of their observations, they lay down as a working hypothesis, that, at present, only when some pathological change has taken place in the walls of the gallbladder or its contents can its shadow be demonstrated on the X-ray plate. Pathological changes mean either thickened walls or the bile of greater density than normal, or greater in quantity, or the presence of stones or calcium in some form. Besides these, there may be changes in the circulation, congestion in blood vessels, changes in lymphatics or other unknown alterations which, singly, or in combination, may be sufficient to cause the gallbladder to show up.

The paper is illustrated by a series of excellent radiographs, showing the outline of gallbladder and stones. R. W. A. S.

Roentgen Ray Findings in the Skull in Cases of Brain Tumours, with Special Reference to the Porus Acusticus.—G. L. Carr (*American Journal of Roentgenology*, August, 1917, p. 405).—Discussing the changes in the sella torcica in cases of brain tumour, Dr. Carr finds that the changes may be caused by direct or indirect pressure. Direct pressure effects are produced by hypophyseal or suprasellar tumours. As the diagnosis of these two types of tumours by radiography has become so exact, she only presents the results of her investigations of the indirect pressure effects upon the sella by an internal hydrocephalus, produced by tumours in the posterior fossa of the skull.

Thirty-two verified cases of cerebellar tumours were studied, and only three failed to show pressure effects upon the sella. In these three cases the distention of the sutures and atrophy of the convolutional impressions were so marked as to account for the negative sella findings.

The changes in the sella vary from a slight haziness of the dorsum sellæ to an enlargement of the fossa, not however to the degree seen in the hypophyseal tumours. The dorsum sellæ may be pressed forward, forming an acute angle with the floor of the fossa. From a slight general haziness of the fossa, the signs may change to those of a very moderate degree of pressure atrophy of the dorsum sellæ, and even to a destruction of the entire dorsum and posterior clinoid processes, and a marked pressure atrophy of the posterior part of the floor of the sella. The anterior clinoid processes rarely show signs of pressure atrophy. The change in the size of the sella is demonstrated by the increase in width of the entrance and deepening of the fossa, the floor in some cases reaching the lower level of the sphenoidal cells.

The other group of tumours in the posterior fossa arises from the cerebello-pontine angle, either from the dura or from the sheath of the auditory nerve within the porus acusticus (internal auditory meatus). These acoustic tumours enlarge the porus acusticus, and this enlargement can be demonstrated by radiography.

Dr. Carr describes the technique by which she finds the internal meatus can be accurately represented on the plate. R. W. A. S.

The Pelvic Colon and Rectum—Roentgenologically Considered.—J. T. Case (*Amer. Journal of Roentgenology*, August, 1917, p. 373).—Case points out that there is a very definite relation between certain symptoms in the proximal portion of the colon and lesions in the terminal 18 or 20 inches of this organ, and the fact that symptoms in the region of the cæcum and ascending colon may be the direct result of pathological conditions in the pelvic colon has not been sufficiently recognised. He believes that in the great majority of cases of constipation, the cause, when mechanical, is to be found in the pelvic colon or rectum, though the subjective symptoms may seem to be more pronounced in the proximal colon. The lesion is often a complex one, and frequently associated with adhesions. These are not only a cause of constipation but often also a result of it, thus causing a kind of vicious circle.

It was formerly believed that the strong peristaltic contractions of the large bowel, completing the act of defæcation, were limited to the portion of the colon below the splenic flexure, but the author has frequently observed them originating in the ascending colon, and even the cæcum. The most favourable time for observing mass movements is immediately after defæcation, and many patients in whom these mass movements have been observed have exclaimed at the time of the movements that they felt as if they could move the bowels.

In the act of defæcation, the large intestine is normally emptied below the splenic flexure, the proximal colon and the right half of the transverse colon being the seat of anti-peristalsis. When the colon is tested by the injection of an opaque enema, the patient should be able to expel the entire enema contents of the colon at one effort, but when the pelvic colon is bound down by adhesions or fixed by the pressure of large pelvic tumours the pelvic loop fails to empty. In some cases there is absolute inability to expel fæcal matter owing to anal fissures, hæmorrhoids, rectal ulcers, or atony of the rectal musculature. Such cases should be classified under rectal constipation. In another class of cases the rectum can only be emptied below the pelvirectal junction owing to a kind of invagination of the too redundant pelvic colon.

Again, in a large percentage of cases, the patient can empty the rectal ampulla, and more or less of the pelvic loop, but no more. On re-examination, it is characteristic that the point of apparent hindrance is always the same, and occurs at the pelvirectal junction, the middle of the pelvic loop, or just below the iliopelvic junction, as the case may be. Case believes such hindrance to be definitely associated with fixation of the colon, usually by adhesions, and their presence may be established by careful fluoroscopic observation of the colon before and after normal defæcation and in connection with the barium enema test, both during its injection and after its expulsion.

When tested by the opaque enema, the ampulla suffers marked dilatation in cases of adherent pelvic colon, the amount of distention depending upon the degree of obstruction, the length of time it has existed, and upon the question whether the patient has made an earnest effort to keep the bowel cleansed by enemas. Some of the most pronounced cases of rectal distention have been observed in patients who have practised the injection of large enemas.

When at the time of the injection of the opaque enema the rectal ampulla is seen to be widely distended, it may be assumed that this is due to one of two causes: either the case is one of marked rectal stasis, with associated dilatation of the rectal ampulla, or it is a case of pelvic colon obstruction. The differential diagnosis between these two conditions can easily be settled by the ingestion of an opaque meal. In rectal constipation the barium reaches the rectum promptly and is delayed there, while with pelvic colon adhesions the stasis is more apt to occur in the proximal colon through the influence of anti-peristalsis, or, at any rate, in the distal colon above the obstruction.

Enterospasm very often attends adhesions of the pelvic colon, but it may also be present as an expression of irritation of any other kind.

Distention of the cæcum, ascending colon, and stagnation of the intestinal contents in this part of the bowel is a most logical result of obstruction in the pelvic colon, whether the obstruction is organic or spastic. The symptoms and findings of the proximal colon are doubtless the result of exaggerated anti-peristalsis. This explains, the author thinks, why appendicectomies for so-called chronic appendicitis are frequently followed by persistence or prompt return of the pains, so much so that patients may doubt the removal of the appendix. The explanation is that the appendix was not the offending organ primarily, but shared in the stasis of the proximal colon; the pains were not appendical but cæcal, and due perhaps to distention rather than inflammation.

The mere determination of the presence of adhesions is not a sufficient indication for operation; there should also be proof of the functional disturbance due to or associated with these adhesions. Case thinks that this fact cannot be too strongly emphasised.

The best means of studying the condition of the rectum is by the opaque enema with the patient lying prone. The average diameter of the rectal shadow is about 5 or 6 cm., but it varies considerably under the following conditions.

As the result of distention owing to increased pressure required to pass the enema above the stricture in the pelvic colon. This stricture may be malignant, it may be due to extra colonic pressure of some tumour, to adhesions of the colon, to tumour of the left tube or ovary, or to the parietal wall, or it may be due to spasm. Spastic contractions of the pelvic colon do not have the same appearance of spasticity as do contractions in the stomach. In the latter, spastic indrawings are usually narrow, well defined, and clear-cut; in the colon, spastic contractions involve whole segments of the bowel, ranging from a few to many inches.

In carcinoma the rectal walls are more or less indurated, depending upon the amount of involvement. The filling defect may vary from a small spot in one side of the rectal shadow to a large annular defect, including almost the entire rectum. The characteristic feature is that it is irregular. A localised malignant lesion may be difficult to differentiate from large indurated rectal ulcers, and should in any case be regarded with great suspicion.

The appearance in rectal syphilis at the time of rectal injection is very characteristic. The rectal channel is converted into a narrow canal, more or less elongated, according to the extent of the lesion. The first portion of the injected material shoots up this narrow canal with astonishing rapidity. The filling defect is smooth-edged and more extensive than in malignant lesions.

In cases of fistula in and when the lesion is a simple, short, non-indurated fistulous tract, injection of the rectum will not show any characteristic deformities. In such cases the introduction of Beck's paste into the fistula will be of much more value, but when the tract is extensive there is likely to be induration sufficient to produce a characteristic defect in the rectal shadow.

In conclusion, Case says that the principal object of his paper is to urge the importance of adhesions of the pelvic colon, of dealing with them surgically in properly selected cases, of adopting an operative technique which will tend to minimize the formation of such adhesions, and of emphasizing the inadvisability to operate for these adhesions when carefully conducted roentgen studies fail to furnish proof of obstruction. The recognition of functional disturbances of the bowel due to the adhesions, spasticity, and abnormal arrangements of the pelvic colon is a matter beset with considerable difficulties, and one that requires the exercise of our best and broadest judgment.

This article is illustrated by a series of excellent radiographs.

R. W. A. S.

CORRESPONDENCE.

To the Editors of ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY.

43, Rodney Street, Liverpool,
December 24th, 1917.

SIRS,

Much has been written on the subject of the localisation of foreign bodies, and many claims as to priority for one method or another have been made. In the December number of this Journal Major Hall-Edwards describes a useful and simple piece of apparatus. In the concluding paragraph of his paper he claims to have first suggested the procedure described, objecting to Major Lewis Cole attributing the use of the pointer to Jordan.

Hall-Edwards' original communication on the subject appeared in the ARCHIVES of January, 1902.

On page 13 of the ARCHIVES for August, 1900 (the apparatus having been demonstrated at St. Bartholomew's Hospital on June 7th, 1900), is an illustrated paper by Dr. Rémy. It is quite evident that this author not only used pointers for the localisation of foreign bodies, but he also arranged for their use during operative procedures, and that they could be removed and replaced during the course of an operation. Additionally he used either two tubes, or displaced one tube, and measured the shift of the foreign body shadow displacement. Essentially he describes the triangulation (screen) method of estimating the position and depth which in its many modifications is so much used at the present time. Possibly there are earlier papers, but at any rate this one is enough to dispose of many of the claims to originality made during the past few years.

Yours faithfully,
C. THURSTAN HOLLAND.

APPOINTMENTS.

Capt. H. E. Gamlen, M.B., B.S., D.Ph., 11th General Hospital. Consulting Radiographer for the Italian Expeditionary Forces.

PUBLICATIONS RECEIVED.

Journals.

American Journal of Electrotherapeutics and Radiology, Nov., 1917.

American Journal of Roentgenology, Nov., 1917.

American Medicine, Nov., 1917.

Archives de Electricité Médicale et de Physiothérapie, Dec., 1917.

Archives de Médecine et de Pharmacie Militaires, Oct., 1917.

Boston Medical and Surgical Journal,, Nov. 29th, Dec. 20th, 27th, 1917 ; Jan. 3rd 10th, 1918.

British Journal of Surgery, Jan., 1918.

Bulletin of the Johns Hopkins Hospital, Dec., 1917.

Cleveland Medical Journal, Dec., 1917.

Gaceta Médica Catalana, Dec. 31st, 1917; Jan. 15th, 1918.

Journals—*continued.*

Good Health, Jan., 1918.

Hospitalstidende, Jan. 2nd, 9th, 1918.

Interstate Medical Journal, Dec., 1917.

Journal of Cutaneous Diseases, Dec., 1917.

Maryland Medical Journal, Dec., 1917.

Medical Journal of Australia, Sept. 15th, 22nd ; Oct. 6th, 1917.

New York Medical Journal, Dec. 15th, 22nd, 29th, 1917 ; Jan. 5th, 1918.

Norsk Magazin for Lægevidenskaben, Jan., 1918.

Policlinico, Il., Jan. 1st, 15th, 1918.

Proceedings of the Royal Society of Medicine, Dec., 1917.

Southern Medical Journal, Dec., 1917.

Ugeskrift for Læger, Nov. 1st, 8th ; Dec. 6th, 13th, 20th, 27th, 1917 ; Jan. 3rd, 10th, 17th, 1918.

NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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A TECHNIQUE FOR THE LATERAL VIEW OF THE UPPER END OF FEMUR.

By R. W. A. Salmond, M.D., Ch.M., Radiographer, General Hospital, B.E.F.

When dealing with conditions in or around the hip joint, the writer has found a lateral view of the head, neck, and trochanters of the femur of much assistance. Little has been written on this subject, and the only paper I can refer to is one by Hickey, some months ago, in the *American Journal of Roentgenology*. The technique we have adopted is, however, different from that of Hickey, and is as follows:—

The patient lies on the couch in the lateral position, with a pillow supporting his head, and with the hip to be examined against the table. The plate is placed in position below the patient and flat on the table.

The lower limb, resting on the table in the lateral position, is now securely immobilised by sand bags above and below the knee and across the foot. The patient is next asked to let his body and the lower limb which is free swing gently backwards, and, in doing so, it will be found that the femur of the immobilised limb does not take part in the movement.

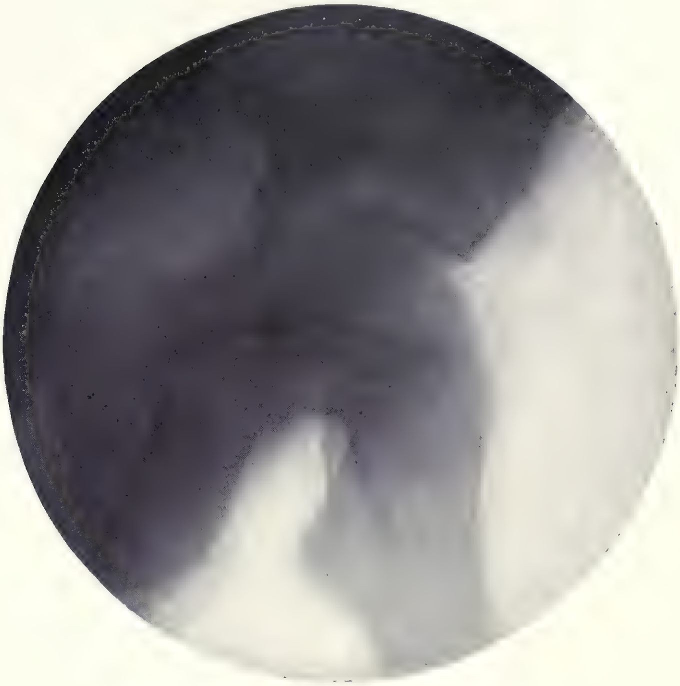


Fig. 1.

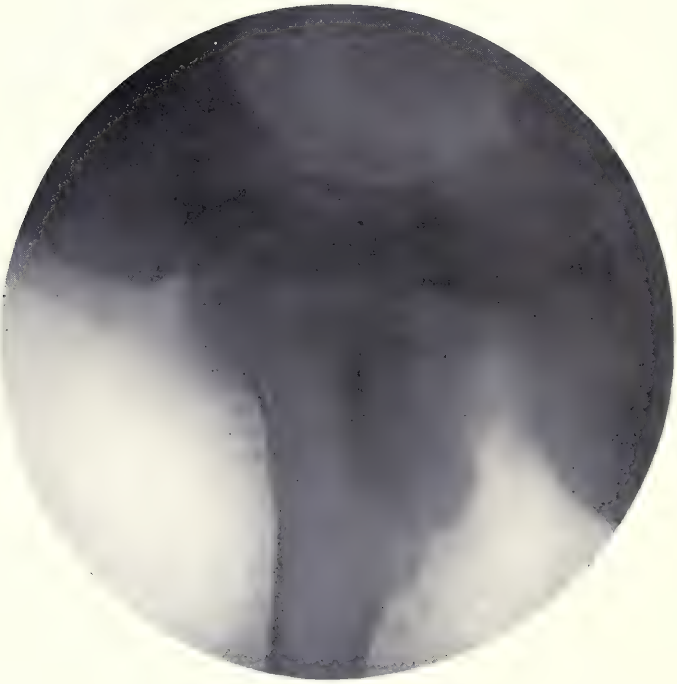


Fig. 2.

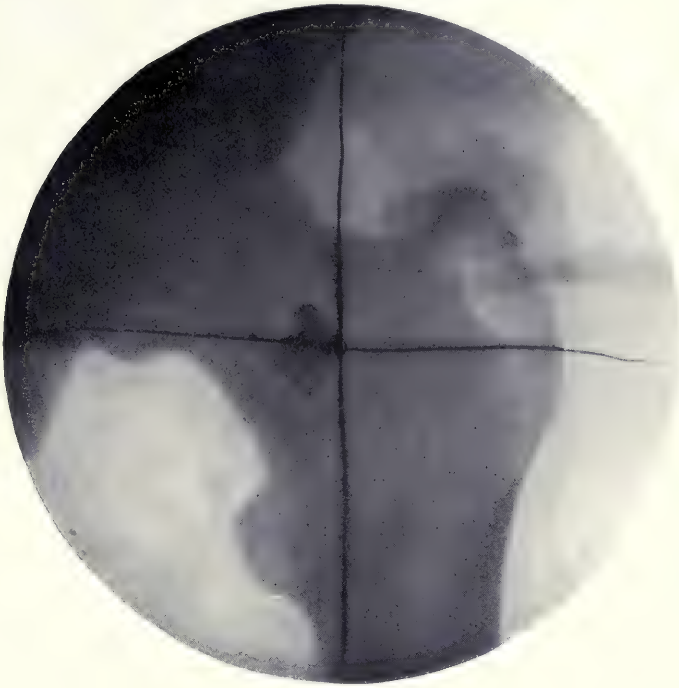


Fig. 3.

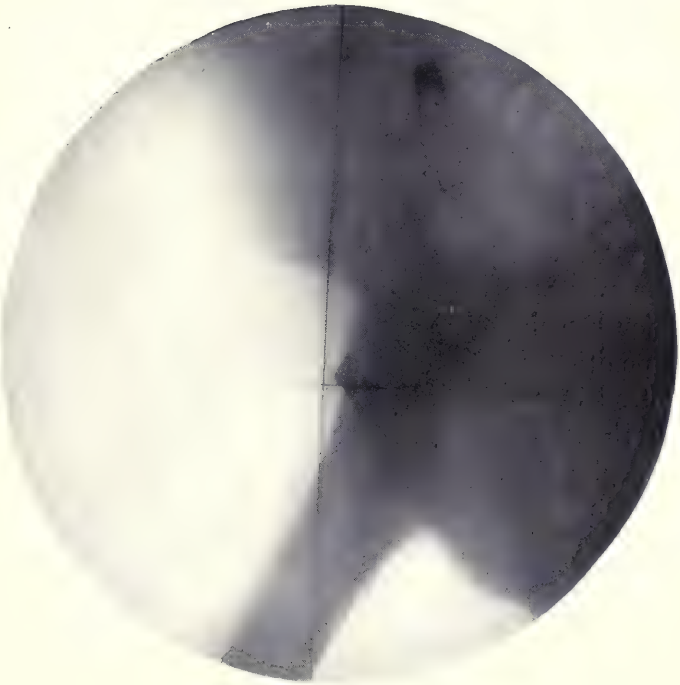


Fig. 4.

What happens is that the pelvis rotates round the head of the fixed femur and the opposite limb is thus got out of the way. Sand bags or pillows are now placed under the patient's chest and back and around the free limb to make him comfortable and to keep his whole body at rest. The tube, overhead and parallel to the plate and table, is then centred over the head of the femur and the exposure made. The extension tube can be brought down to the surface of the skin without interference with the opposite thigh or side of pelvis. Stereoscopic views can also be taken in this position.

The result is a true lateral view of the outline of the head, neck, and trochanters of the femur (Figs. 1 and 2), though not, of course, of the pelvis, as it has rotated. Because of this the view cannot be properly described as a lateral one of the hip joint. As a test that a true lateral view has been obtained, the posterior dense margin of the femoral shaft should be seen running up to and becoming continuous with the outline of the lesser trochanter, and should not be seen running across its base independently.

If desired, the tube may be used underneath, the position screened, and exposure made with the patient in exactly the same position, but the greater trochanter and neck of femur are now further from the plate, and it will generally be found that this arrangement is not so convenient as with the tube overhead.

It is not necessary for the thigh to be flexed, and, unless there is ankylosis of the joint, the pelvis can be sufficiently rotated to carry the opposite limb out of the paths of the rays. In some cases, the scrotum and penis will be found to overlap the joint, but a broad strip of fine gauze or bandage, fixing them to the opposite thigh, will keep them clear.

Fig. 3 is from a case which illustrates the value of this position. A piece of metal was found lying in relation to the neck of the femur, and localised as being 5·75 cm. deep to a mark on the front of the thigh with the limb in a definite position. This position was not true antero-posterior, as shown by the extent of shadow of the lesser trochanter (Fig. 3), because the patient was in much pain unless his thigh was slightly rotated outwards. Stereoscopic laterals, one of which is shown in Fig. 4, showed the foreign body to be lying very close against the anterior surface of the neck. At the operation, the surgeon, Major Everidge, dissected down to the neck and found the piece of metal in the position indicated, the surface of bone against which it lay being slightly pitted by the metal.

The position that has been described is in no way intended to take the place of stereoscopic antero-posterior views, but is simply put forward as affording a view which is not seen in any antero-posterior view, is easy to obtain, and in the writer's experience has been of real use in several cases.

I wish to express my indebtedness to my senior N.C.O., Corpl. H. B. Craft, for his valuable help while experimenting on this position.

SOME MODERN DEVELOPMENTS IN ROENTGENOLOGY.*

By L. Erasmus Ellis, M.D.

(*Continued from p.* 284.)

Coming now to the purely radiographical portion of this subject, a very large field is opened up, so vast in fact that one could write interminably upon it. Owing to the limited time at my disposal, however, I propose confining myself to a portion of one section of radiography only, namely the X-ray examination of the gastro-intestinal canal. The principle of this examination is the observation of certain inert opaque substances, swallowed by the patient, during their passage through the various portions of the digestive canal. Some salt of either bismuth or barium is generally used, and may be suspended either in a mucilage or some form of fluid or semi-fluid food. Beginning with the œsophagus, one observes the passage of first a fluid and then a more solid form of food, and in this way growths, strictures, pouches, and in fact any similar abnormality of the œsophagus may be detected. The entrance of food into the stomach is then observed, and also the behaviour of that organ on receiving and dealing with its contents. The exit of the meal from the stomach and its passage through the duodenum and other portions of the small bowel are closely followed, its entrance into and progress through the cæcum and colon are generally observed, and finally its advent into the rectum is noted. The technical features of this lengthy examination I will not enlarge upon, but much interesting and valuable information can be gathered. For ascertaining the condition of the stomach and small bowel a one-day examination usually suffices, but in certain conditions of the large bowel it may be necessary to allow one's observations to extend over several days. Occasionally in certain conditions of the lower bowel the administration of an opaque enema is preferable to the ingestion of the usual "meal."

Reflex actions may be observed and are also most instructive. A clinical diagnosis of a lesion in one part of the digestive tract is sometimes quite justifiably made, but the X-ray inspection reveals a totally different portion of the digestive tract as being at fault. Thus in a case of acute gastric vomiting one may find an organically perfectly normal stomach, but a kinked or diseased appendix may be discovered, which has produced the vomiting as a reflex phenomenon. A gastric or duodenal ulcer may not itself be demonstrated, but its presence may be diagnosed by the abnormal behaviour of the digestive tract generally.

Interest very usually attaches to the appendix, that organ which in recent years has proved so fertile a source of disease, but in many instances it is difficult to demonstrate by X rays, for it is not visible unless some of the opaque meal enters its canal. The difficulty in this occurring can be imagined, when one realises that sometimes the lumen is so small that it will only just admit a fine bristle. In many cases, however, the appendix readily allows the more fluid contents of the bowel to enter its canal and with it the opaque salt held in suspension. When this happens, a skiagram of this interesting vertigial relic may be obtained and a few illustrative slides of the appendix may be of interest at this stage.

---

* Being a paper read before the South African Institute of Electrical Engineers, Johannesburg, 21st June, 1917.

The results of operative interference may be followed and much useful information obtained, especially in cases where the symptoms do not clear up after operation, thus providing invaluable assistance to a, sometimes, puzzled surgeon.

My remarks would be quite incomplete did I not mention the subject of malignant growths in connection with the radiographical investigation of the gastro-intestinal tract. In cases of early cancer it is often quite difficult to detect the disease by X-ray examination. More advanced growths are, however, easier to demonstrate. Sometimes one can, by reflex phenomena, form a fairly accurate idea of the presence and situation of a growth. This, combined with clinical symptoms and the history of the case, may confirm one's opinion that the invasion is a malignant one. In advanced cancer, however, plain indications of a growth may be obtained by X-ray examination.

Many twists and kinks of the bowel may be shown by this method of investigation, one of the most common of which is that very interesting condition known as Lane's kink. This owes its name to the eminent London surgeon, Sir Arbuthnot Lane, who has so fully investigated and described it. Its formation is often associated with chronic or sub-acute inflammation of the appendix, and consists of a drawing down, and, often, rolling over upon itself of the terminal six inches or so of the small bowel, just where this latter enters the large bowel. This produces a partial obstruction to the passage of the bowel contents, in addition to being responsible for certain secondary symptoms and reflex phenomena. The appendix is often adherent to this portion of the ileum forming the Lane's kink, helping to produce the latter, and incidentally the appendix may be adherent to adjoining structures as well.

Malpositions of the gastro-intestinal tract in regard to kinks, bends, dropping, and both congenital and acquired irregularities, are frequently seen, while dilatation or atrophy, with other abnormalities, often associated with constipation or intestinal irritation, are commonly observed.

Finally, investigation is being carried out as to the ordinary behaviour of the stomach and intestinal tract, for, strange as it may appear, we are remarkably ignorant of many of the normal aspects of the digestive canal. Before the advent of X rays the stomach was always regarded as being a bag-like or pear-shaped organ, placed across the abdomen, as this impression is conveyed both under anæsthesia and postmortem. X rays have, however, proved that is ita J-shaped viscus, situated to the left of the middle line, in practically a

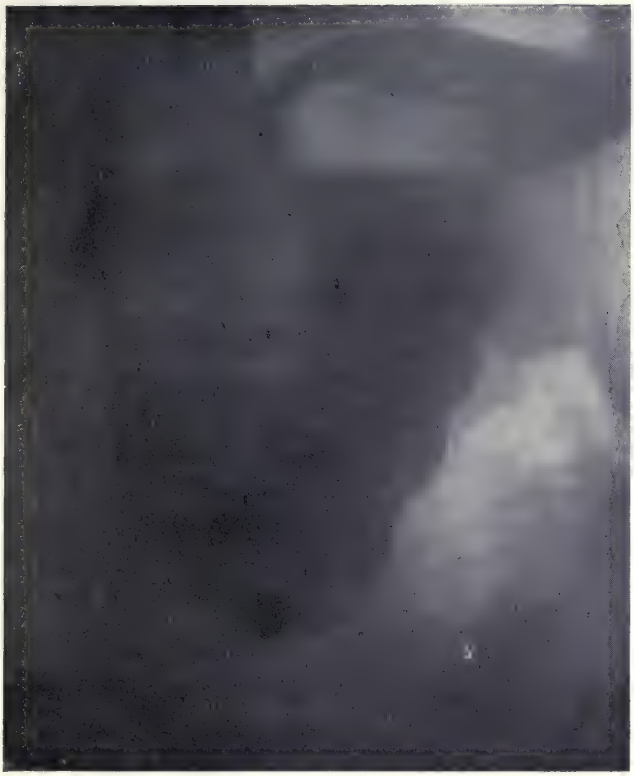


Fig. 1.—*Normal Stomach.*

Note the unusually symmetrical waves of peristalsis sweeping along both curvatures.

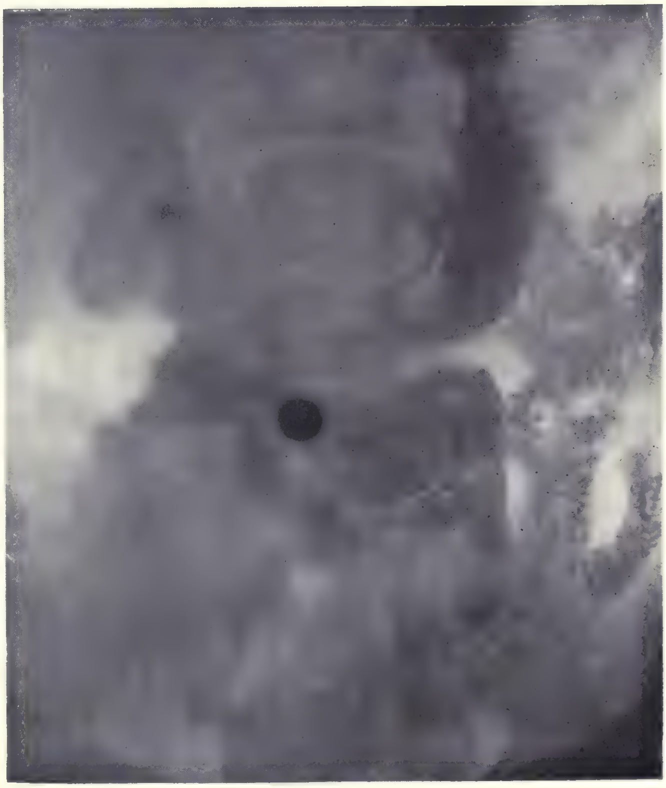


Fig. 2 —*Stomach and Small Bowel.*

The stomach is seen partly empty and in the act of expelling the rest of its contents. A sharp kink is shown in the duodenum, probably the result of an adhesion due to inflammation around the gall-bladder. The flocculent appearance of the contents of the jejunum is defined in contrast to the denser outline of the ileum. The opaque disc represents the position of the umbilicus.

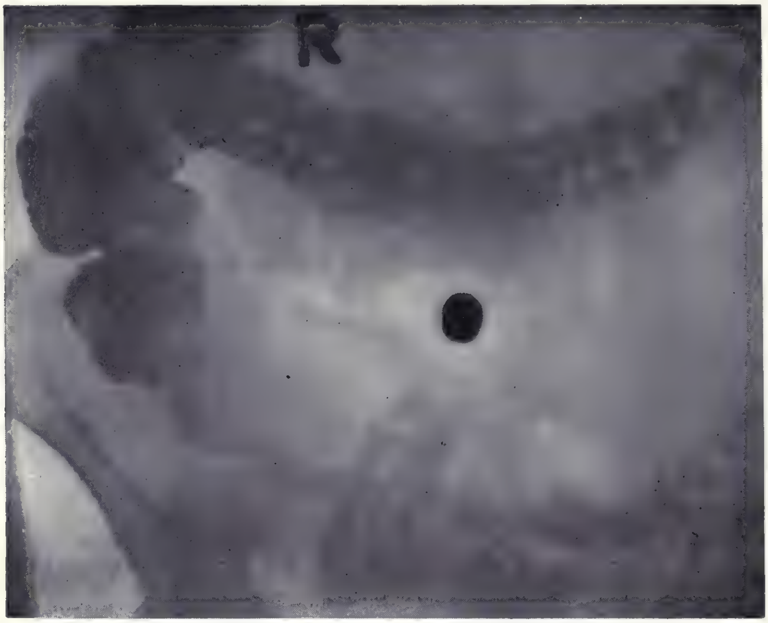
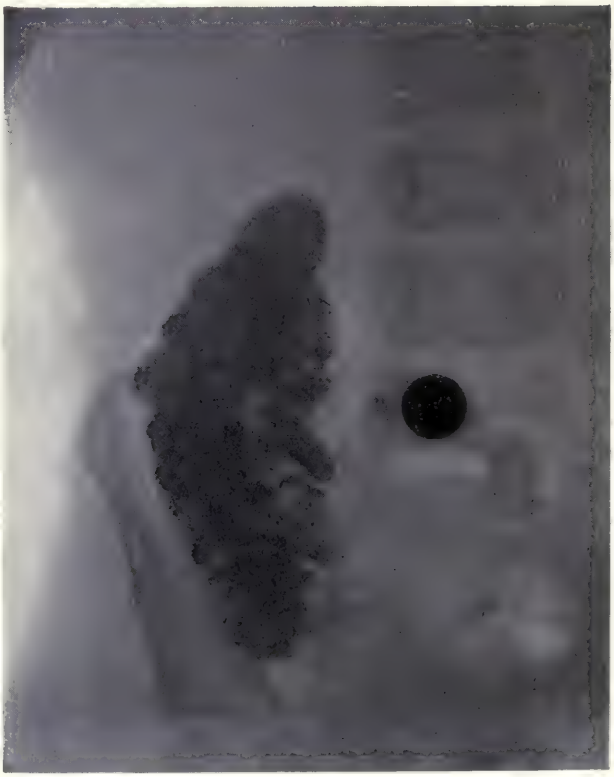


Fig. 3.—*Normal Large Bowel.*

Fig. 4.—*A Kinked Appendix.*

Note the appendix coming off the lower end of the cæcum and running upwards and inwards till it kinks suddenly and then runs downwards and outwards. This condition, which occurred in a boy of 6 years of age, produced reflex gastric vomiting.



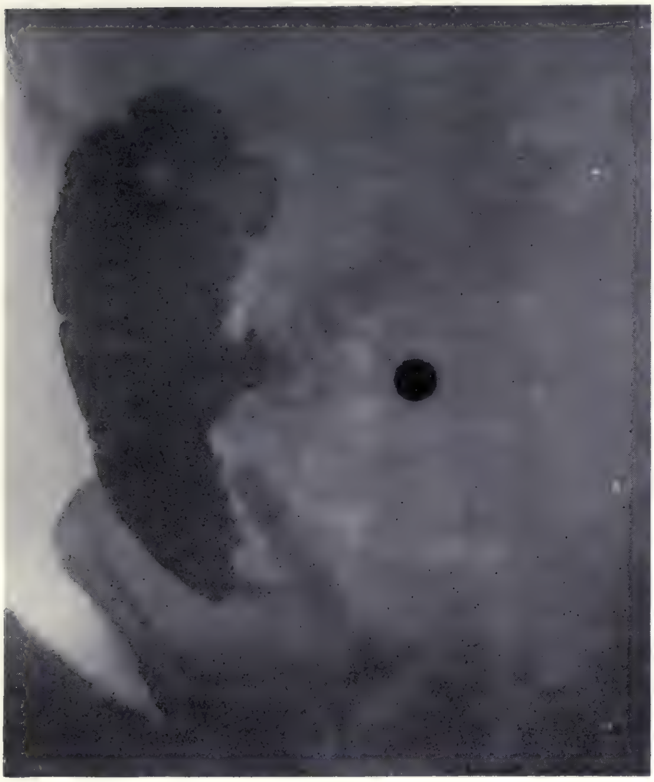


Fig. 5.—*Showing the Appendix and a Lane's Kink.*

A thick appendix is shown coming off the lower end of the cæcum and running directly inwards till it meets the terminal portion of the ileum, to which it is adherent. A Lane's kink is formed in the last part of the ileum.

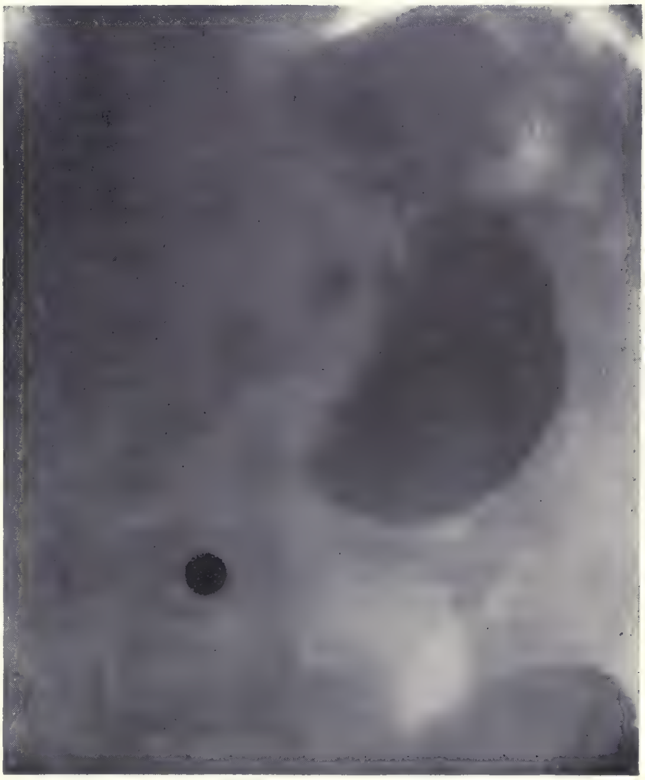


Fig. 6.—*Malignant Growth of the Stomach.*

This skiagram was taken immediately after the ingestion of the opaque meal, and yet a small mass of barium is to be seen internal to the general mass of the stomach. It could only have reached this position through an abnormal channel out of the stomach, and this was supplied by a malignant growth. A spasm of the stomach is shown at the level of the growth.

vertical position ; in fact it is now regarded as a but slightly modified part of the digestive tract, instead of a veritable "bread-basket." The method of progress of food in the small bowel has only been ascertained since instantaneous skiagrams have been possible. It is now recognised that in the jejunum, or earlier part of the small bowel, the contents are divided up into a fine, flocculent mass, which progresses in a peculiar manner, equivalent to an individual taking three steps forward and two back. In the colon, however, the advance of the contained matter is quite different and also very characteristic. In the latter three quarters or so of the colon the contents lie quiet, and apparently dormant, for many hours, then, suddenly, the whole is observed to be shot along for a considerable distance and then to settle down again and be quiet for a variable, though often protracted period. Reverse peristalsis may also occur either in the colon or other portions of the intestinal tract, generally as a result of the partial or more complete obstruction of the bowel.

I have, Mr. President and Gentlemen, in the foregoing remarks endeavoured to briefly bring to your notice some of the salient points in reference to recent advances in Roentgenological work. You will probably, however, have observed that much development lies before us, both in the production and the application of X rays or some element or force that may accomplish the object at present aimed at by Roentgenology. In what direction this advance will take place it is impossible to say, or what the developments in the way of the penetration of opaque matter may be, it is difficult to surmise. One feels, however, that the time is at hand when the liberation of many of the immense forces of nature will occur and many scientific ideals will be accomplished. When the present destructive and devastating war culminates, as we all feel sure it will, in the vindication of the high ideals of justice and liberty aimed at by the Allied Powers, then, under an uninterrupted peace, science will be enabled calmly to work her sure and certain course. Roentgenology will, at that time, receive a due share of consideration, and a resulting advance will take place which will justify such a paper as I have laid before you this evening being regarded as very elementary if not absolutely antiquated. That this climax may not long be deferred, is, I am certain, the earnest wish of every one of us.

A CONVENIENT METHOD OF HEATING THE SPIRAL OF THE COOLIDGE TUBE.

Demonstrated to the Electro-Therapeutic Section of the Royal Society of Medicine, November 16th, 1917.

By Alfred C. Jordan, M.D., M.R.C.P.

Hon. Radiologist, Fishmongers' Hall and Queen Alexandra's Hospitals for Officers, and Royal Hospital for Diseases of the Chest.

The Coolidge tube is now in wide use, and its many advantages are admitted. Because of its increasing popularity it is important that the accessories required for its use should be convenient, and should not need too much care or attention.

In my own experience the only trouble with the Coolidge tube has been the care of the accumulators used to supply the current for heating the cathode spiral. In hospital work in particular the battery is frequently out of repair.

Many suggestions have been made, and several expedients are in use for heating the spiral by other means.

The most obvious method—to use the main supply, suitably cut down—has been negatived till recently by the need to insulate the cathode from earth. This restriction is not absolute, as demonstrated by Dr. J. A. Shorten (Archives of Radiology and Electrotherapy, August, 1917), who has shown that it is possible, and in the humid climate of India advantageous, to "earth" the cathode.

There are objections to this course, the chief being (as Shorten points out) the undue strain on the coil. No doubt coils could be constructed with insulation so perfect that they would stand the extra strain, but the fact remains that the average coil in use now would deteriorate rapidly, and might actually break down (as happened in the case of one of Shorten's coils).[1]

Clearly then it is essential to devise a method (of heating the Coolidge spiral) which permits of the complete insulation of the cathode. This has already been accomplished in two ways at least :—

1. By means of an alternating current step-down transformer.
2. By a continuous-alternating generator, and a Tesla transformer in oil.

Where an alternating supply is available No. 1 method is the simplest.

With a continuous current supply No. 2 is no doubt satisfactory, but is expensive.

A simpler arrangement suggested itself to me, viz., to use an interrupter in conjunction with a small step-down transformer. The secondary winding supplies the current to heat the Coolidge spiral. An adjustable rheostat in the primary circuit provides the fine regulation. This rheostat is attached to the control table, and thus the temperature of the spiral is regulated with great ease and exactitude while the tube is "running."

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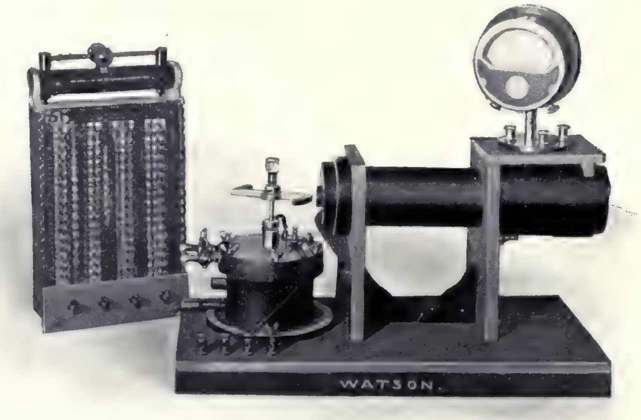
[1] At the preceding meeting of this Section (October), Captain Hernaman-Johnson described the means whereby he had actually carried out Shorten's suggestion to use the direct current from the main for heating the spiral of the Coolidge tube.

A motor-magnetic interrupter is used, and the only constructional problem is to get sufficient insulation between the primary and the secondary circuit. This has proved a simple matter. Messrs. Watson are making and supplying the little apparatus (at a cost not much greater than that of the insulating stand with accumulators and adjustable rheostats supplied heretofore).

The accompanying illustration shows the details so clearly that no additional description is needed.

A feature of my transformer that must be borne in mind is the fact that the current needed to heat the spiral, as indicated by the amperemeter, is a good deal less than with a battery. At Fishmongers' Hall, for instance, the spiral of the tube needs 4.8 amps. with a battery, but only 3.5 amps. with my transformer. If this difference be remembered there will be no accidents due to overheating the spiral.



It remains for me to state that in practice my method of controlling the temperature of the cathode spiral of the Coolidge tube has proved perfect, giving a uniformly illuminated screen, free from flickering, and from changes of intensity. The heating device can be run for hours at a time. The interrupter needs no attention for long periods; it receives no more than 3 or 4 amps. on a 240 volts circuit.

Once the advantages of a transformer are generally known, I am convinced that a battery will cease to be used with the Coolidge tube.

A CONTRIBUTION TO THE STUDY OF DOSAGE IN RADIUMTHERAPY.

By J. C. Mottram, M.B. Lond., and S. Russ, D.Sc. Lond.

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The information upon radium dosage contained in this paper was derived from experimental observations which were made upon a patient admitted to the cancer wards of the Middlesex Hospital, suffering from carcinoma of the breast. The patient was under the care of Mr. Comyns Berkeley, who gave us every opportunity to pursue our investigations, and we should like to express here our indebtedness to him.

Part I.—Description of the Case.

The patient is a single woman, aged 53. Seven years ago, at the age of 46, she first noticed a small tumour under the skin of the left breast, close to the nipple, which soon became retracted. Three years ago numerous nodules appeared in the skin of the trunk and head. About this time she became a patient at Guy's Hospital, where she had X-ray treatment for some months, with no good effect. Soon afterwards the skin over the growth in the breast became discoloured and broke down, leaving an ulcerated surface upon which a dry crust formed; the nipple was involved in this ulceration. Cutaneous and sub-cutaneous nodules continued to appear upon the trunk and head.

Eighteen months ago she was admitted to the cancer wards of the Middlesex Hospital. On admission, she was found to be somewhat wasted and pale. The left breast presented at the site of the nipple a small puckered ulcer covered with a dry crust; the surrounding skin was discoloured and the tissues invaded with growth forming a mass of superficial area 1½ in. by 2½ in., somewhat adherent to the chest wall. Numerous cutaneous nodules of growth were found scattered over the head and trunk, ranging in size from ½ in. in diameter to minute nodules only palpable with difficulty. Upon the chest and abdomen in front thirty-nine nodules were found, upon the back forty-two. Several were present on the face, of which the patient was especially conscious as they interfered somewhat with the contraction of the facial muscles. Several large nodules were found on the scalp, giving rise to bald patches. No enlarged lymphatic glands were found, nor any evidence of other secondary growths.

Since the patient has been under observation, her general condition has much improved. The growth in the breast remained unaltered until radium treatment was applied: First application, 3 mg. for sixteen days; second application, 3 mg. for twenty-seven days; screen 1 mm. lead, area of application 40 sq. cm. After the second application a transient erythema was observed; this was followed by a falling off of the crust which covered the ulcerated surface. The skin over the growth was then found to be intact; the growth appeared to have diminished somewhat in size, in which condition it has since remained.

Since admission, many of the cutaneous nodules have disappeared under experimental applications of radium; on the other hand, many fresh nodules have appeared, and some of the original nodules have increased in size. A few nodules have appeared on the limbs, more especially on the thighs. No evidence of secondary growths in other situations has been found.

From the above description, it is seen that the case presents unusual features. The progress of the disease is very slow; the primary lesion, after seven years, remains very localized in the superficial tissues of the breast; numerous secondary growths are present, and these are entirely confined to the skin.

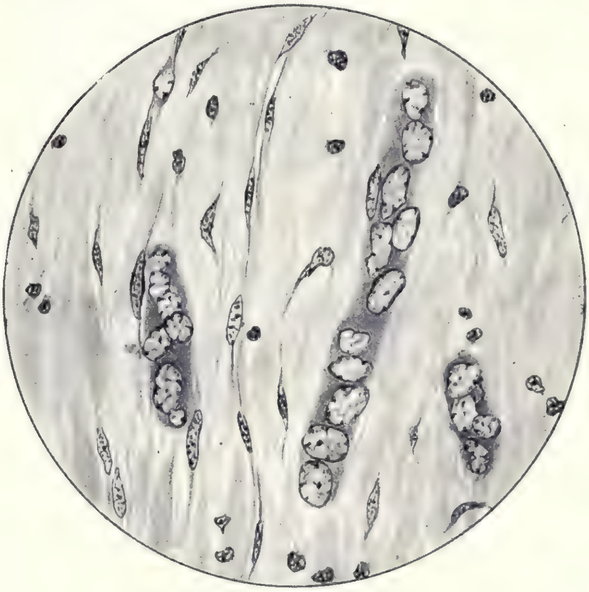

Fig. 1.

This type of cancer of the breast, though rare, has been several times described under such terms as "acute miliary carcinosis" and "disseminated scirrhus."

Pathologically the condition is said to be due to the early invasion of the lymphatics of the skin by a growth arising in the superficial parts of the breast, and the subsequent spread of the growth over the skin of the whole body by means of the cutaneous lymphatics.

Histology.—A small subcutaneous nodule from the back, on section, presented a scirrhus type of glandular carcinoma. Scattered through a moderately dense, fibrous, connective tissue were small elongated cell masses. These consisted of pencils of undivided and undifferentiated or very finely granular protoplasm, containing numerous large, oval, not very granular nuclei (see Fig. 1). In many cases these cell masses were seen to be lying in lymphatic channels (see Fig. 1). The connective tissue contained few cells, chiefly fibro-blasts and tissue lymphocytes.

The Action of Radium Rays upon the Skin.—The skin changes resulting from exposure formed a progressive series, and are conveniently described under the following headings, given in the order in which they made their appearances: Erythema, œdema, scaliness, pigmentation, blister formation, dry exudation, moist surface, hæmorrhage, healing, hair destruction, leucoderma, and enlarged venules.

Erythema varied from a faint pink to a deep dusky colouration. It was often the only skin change following exposure to radium, and in no case have other skin changes been observed not preceded by erythema.

Œdema.—In a few cases a transient œdema was observed six hours after exposure, more especially when intense sources of gamma rays were employed.

Scaliness and Pigmentation commonly succeeded the primary erythema. In many cases, however, these changes were masked by the more profound changes, such as exudation, following large doses of radiation.

Pigmentation often persisted for many months. In a few cases the erythema was followed by the formation of a shallow *blister*, which either dried up or became a moist surface discharging serum. In a great number of cases the irradiated area became covered with a heaped up *dry exudation* or crust, resulting from the slow discharge of serum, which dried as quickly as it was discharged. In other cases the rate of discharge of serum did not permit of it drying locally, and thus a *moist surface* resulted. In a few cases in which the injury was more severe, the discharge of serum from the moist surface was blood-stained.

In all cases these skin reactions were followed by *healing*, but in many cases permanent alteration of the skin resulted: there was either partial or complete *destruction of the hair*.

If ulceration of the skin had occurred, accompanied by either a dry exudation or a moist surface, then, after healing, a permanent absence of pigmentation (*leucoderma*) was frequently observed; this was associated with a thin, glossy, hairless skin, as is often seen in the scars following other skin injuries. A final permanent change in the irradiated skin consisted in the formation of *dilated venules;* this was always accompanied by leucoderma, and only followed the severe ulcerations.

The Effects of Exposure to Radium upon the Cutaneous Nodules of Growth.—These varied from complete or permanent disappearance to *no* appreciable alteration. Many intermediate effects were noted; for instance, a temporary disappearance with subsequent recurrence; a temporary diminution in size; a temporary stoppage in growth. Owing, however, to the small size and varying depth of these nodules, it was found impossible to measure their size from week to week, and thus to follow in detail the growth of each nodule. For this reason observations were confined to the estimation whether or not the nodules had disappeared (to palpation) after exposure to radium. In the tables in Part II the nodules are divided into large and small, and the time of their disappearance is given in days; but in view of the varying size and depth of the nodules, and the variation in the thickness of skin upon different parts of the body, these periods of time can only give a rough indication of the effect of the various doses of radium which were applied. The conclusions in this paper, as regards the effect of radium on the disappearance of these tumours, have been made with this reservation prominently in view.

Part II.—Details of the Investigation.

The study in dosage which has been made, both upon malignant nodules and upon the skin, has necessitated a certain number of measurements of the radiation emitted by the various radium applicators which have been used, and of the absorption which such radiation suffers by the various screens employed. It has also been necessary to compare the amounts of radiation actually absorbed by the skin and subcutaneous tissues, when exposed to the different types of rays, beta and gamma, which have been utilized. For these purposes, a gold-leaf electroscope, which has already been described before this Section, was employed. The main feature of the instrument is that the depth of the chamber in which ionization is produced by the rays is varied to suit the particular requirements of the case.

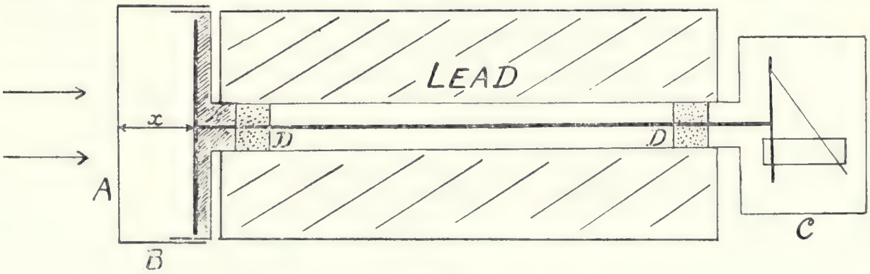

Fig. 2.

The ionization chamber consists of a cylindrical box *B*, provided with a window *A*, covered with very thin aluminium (0·001 mm.). When the rays from an applicator are allowed to enter this chamber, they ionize the air in it, and this is indicated by a movement of the gold-leaf in *C*, which is electrically connected to the electrode in the chamber *B*. From the rate of movement of the gold-leaf over a graduated scale, accurate measurements may be made of the intensity of the radiation employed, and of the extent to which such radiation is absorbed by filters or by tissues intervening. For such measurement the depth x of the chamber *B* is generally kept at about 1 cm. When filters are employed with an applicator, the radiation received by the skin is reduced, both by reason of the absorption which the rays suffer and on account of the increased distance of the applicator from the skin. The former is calculated from measurements which have been described. To determine the latter correction, the depth x is reduced to about 1 mm., and the applicator brought up flush with the window *A*; the ionization is measured, and the applicator now moved back 1 mm. at a time and the diminution of the ionization obtained for each distance.

It will be seen that measurements made in this way, with a very shallow ionization chamber, provide data which are applicable to the case of radiation incident upon, and absorbed by, the succeeding layers of the skin.

One of the objects of the present study has been to compare the effects produced upon the skin when it is irradiated in such a manner that equal amounts of beta and gamma ray energy are absorbed by it. Roughly speaking, we may say that the gamma rays from a radium capsule screened by 2 mm. of lead are about fifty times as penetrating as the beta rays from the same capsule unscreened; in order that the skin should absorb the same amount of beta and of gamma rays it is found that either the time of exposure in the latter case must be about fifty times that in the former if the same capsule be employed, or in order that the time of exposure may be the same, another capsule of about fifty times the strength must be employed. It will be seen from the results recorded that quite different effects are obtained when the time of exposure is very prolonged to those resulting from a short exposure using an intense source.

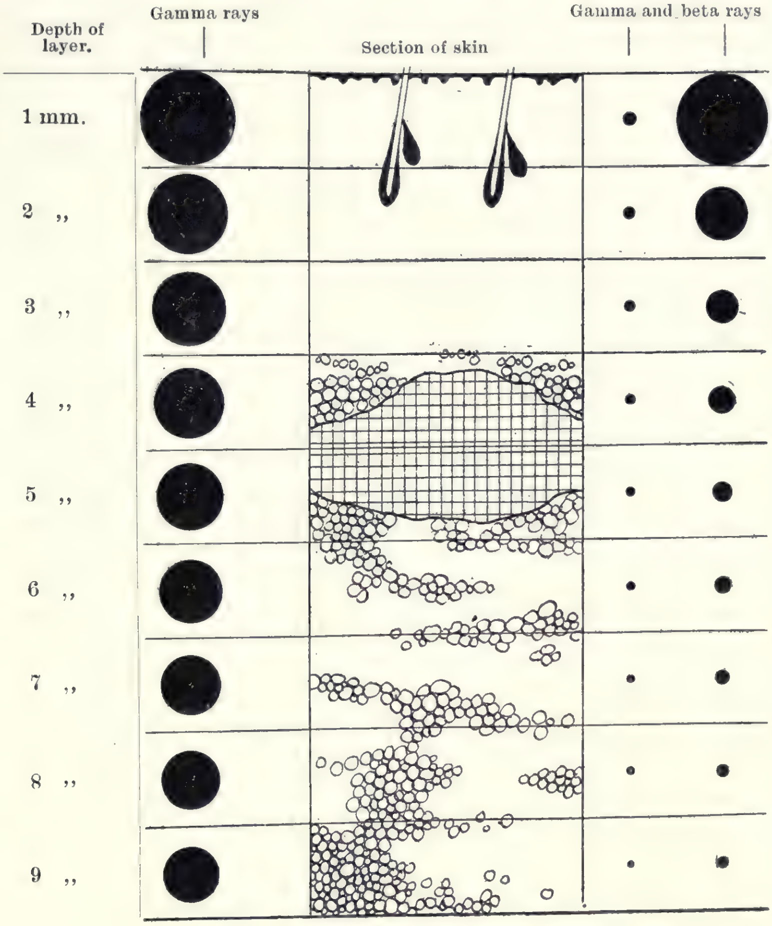

Fig. 3.

Fig. 3 represents diagrammatically a section of skin with a nodule situated a few millimetres below the surface. On the right are circles, the areas of which correspond to the amount of beta and gamma ray energy absorbed by each succeeding layer; on the left are the corresponding circles in the case of screened radiation—*i.e.*, of gamma rays only. In both cases it is arranged that the same amount of energy is absorbed in the first layer, 1 mm. in thickness; this, for convenience, we may take to be 100 units.

When the attempt is made to adjust the dose of radiation administered so that the skin shall absorb the same amount of beta and gamma ray energy, it will be seen from the diagram, Fig. 2, and the data in Table A, that this can only be done for a single layer, owing to the different degree to which the two kinds of rays are absorbed by the tissues. If adjustment to equality is made for rays absorbed by the top layer of the skin, then the layer, situated at a depth of 5 mm., will absorb about twenty times as much of gamma ray as beta ray energy. It is found, in fact, under these conditions, that rather more profound changes are produced upon the skin by gamma rays than by beta rays, when steps are taken to ensure the equality of radiation absorbed at the surface.

It may well be that disturbances which are seen at the surface, are the sum total of the effects produced at the different layers, so that this more marked reaction to the gamma rays is rather to be anticipated if such reaction is simply a question of the amount of energy absorbed by the cells.

TABLE A.—RADIATION ABSORBED BY FIRST LAYER = 100 UNITS IN EACH CASE.

Depth of layer below surface of skin	Unscreened rays		Screened rays (gamma rays only)
	Beta rays	Gamma rays	
1 mm.	98·00	2·00	100·0
2 mm.	31·20	1·40	70·0
3 mm.	13·10	1·27	63·5
4 mm.	7·56	1·12	56·2
5 mm.	4·71	1·01	50·8
6 mm.	3·24	0·92	46·0
7 mm.	2·25	0·83	41·8
8 mm.	1·57	0·77	38·5
9 mm.	1·18	0·70	35·5
10 mm.	0·94	0·66	33·4

On the basis of these and similar data for the various capsules employed, a series of quantitative studies (Nos. 1 to 4 in what follows) has been carried out, each of which will receive separate and detailed consideration.

Dosage Study No. 1.

"*Comparison of the Effects of Beta Rays, according as a Large Quantity is used for a Short Time, or a Small Quantity for a Long Time.*"—For this purpose two capsules of the same area were used: one contained 7 mg. and the other 0·018 mg. radium bromide (hydrated). Subcutaneous nodules were exposed to the two capsules and observations subsequently made of the effect of the radiation upon the nodule and upon the superimposed skin. The data are collected in Table I. Attention may be drawn to two findings: (1) The *time* taken for the reactions does not vary appreciably whether the exposure be two or as much as six hours, but the *degree* of such reaction corresponds with the length of exposure; (2) there is much less effect upon the skin when it is exposed for a long time to a weak source, than when a strong source is used for a short time. It will be seen that no permanent alteration in the skin occurs when it is given an equivalent of four hours exposure, using a weak source for a long time; with the strong source, however, this exposure results in loss of hair, leucoderma, and the formation of venules. The effect upon the nodules, however, is very nearly the same in the two cases, which brings into contrast the behaviour of the malignant cells with that of the normal cells of the skin. The same contrast will be seen later under different experimental conditions.

TABLE I.

Quantity of radium bromide in milligrams	Exposure	DAYS REQUIRED FOR REACTION										
		Erythema	Scaliness	Pigmentation	Exudate	Moist surface	Healed	Hair	Leucoderma	Venules	Nodule	
											Small	Large
7·0	1 h.	22	—	—	—	—	—	No permanent alteration			N.P.	
	1½ h.	3	—	—	—	—	—	No permanent alteration			N.P.	
		9	33	—	—	—	—				37	
		14	—	—	—	—						N.P.
	2 h.	1	21	—	+	—	37	Absent		—	36	
		3	—	—	30	—	41	Absent	+	—		47
	2½ h.	3	—	—	29	—	57	—		—	57	
	4 h.	1	14	—	21	—	37	Absent	+		36	
		5	25	—	29	—	46	Absent	+	+		67
0.083	3d. 12 h. equivalent 1 h., 7 mg.	14	—	100	—	—	—	No permanent alteration			N.P.	
		19	—	100	—	—	—					N.P.
	7 d. equivalent 2 h., 7 mg.	6	24	+	—	—	—	No permanent alteration			42	
		7	23	35	—		—					N.P.
	14 d. equivalent 4 h., 7 mg.	3	44	31	—	—	—	No permanent alteration			46	

Area of capsules, 3·14 sq. cm.
Screen, 0·1 mm. aluminium, 1 layer of lint.

N.P. signifies "nodule persists."

DOSAGE STUDY No. 2.

"*Comparison of the Effects of Screened Beta Rays under Various Conditions of Irradiation.*"—In this series two capsules were used: one contained 7 mg., spread over an area of 3·14 sq. cm., and the other, 24 mg. over an area of 0·5 sq. cm., thus having an intensity 24·4 times greater than the first. The exposures were all based upon the experience gained with the 7 mg. capsule unscreened. Two hours exposure with this capsule led to a definite clinical picture, the final phase of which was a loss of hair and leucoderma. When a screen of aluminium 1 mm. thick is placed between such a capsule and the skin, the dose of rays received by the skin is reduced to about 13·5 per cent.; consequently, in order to adjust the surface dose to equality, the time of exposure must be increased from two to fifteen hours, *vide* first observation, Table II. Although this dose gave rather a slighter disturbance than when unscreened rays were used, generally speaking, the reactions observed, whether the rays were screened or unscreened, were essentially of the same kind when the dose absorbed was adjusted to equality. With the small capsule of high intensity, distinctly more marked effects were obtained upon the skin than with the weaker source.

TABLE II.

Quantity of radium bromide in milligrams	Exposure	Equivalent	DAYS REQUIRED FOR REACTION										
			Erythema	Scaliness	Pigmentation	Exudate	Moist surface	Healed	Hair	Leucoderma	Venules	Nodule	
												Small	Large
7	15 h.	2 h.	2	—	—	—	—	—	None	—	—	N.P.	
	15 h.	2 h.	—	—	42	—	—	—	Some hair	—	—		N.P.
	18¾ h.	2½ h.	—	—	—	slight 20	—	33	None	—	+	52	
	22½ h.	3 h.	—	—	—	21	—	35	None	—	—	60	
	30 h.	4 h.	4	—	—	19	—	39	Some	+	—	43	
		—	7	21	—	28	—	48	None	—	+		100
	48 h.	6½ h.	3	15	—	24	27	38	None	+	+		45
24	10 m.	½ h.	7	38	—	—	—	—	No permanent alteration			76	
	20 m.	1 h.	2	21	—	27	—	30	No permanent alteration			101	
	60 m.	3 h.	3	21	—	24	—	31	None	—	—	31	

Area of 7 mg. capsule, 3·14 sq. cm.
Area of 24 mg. capsule, 0·5 sq. cm.
Screen, 1 mm. aluminium, 1 layer of lint.

N.P. signifies "nodule persists."

This finding is analogous to that recorded in Study No. 1. The source of high intensity appears to be more effective in its action upon the nodule than the weaker source. Whether this be due to the shortened period of irradiation, or to the small size of the nodules which were under observation, it is not possible to say.

TABLE III.

Quantity of radium bromide in milligrams	Exposure	Equivalent	Days Required for Reaction										
			Erythema	Scaliness	Pigmentation	Exudate	Moist surface	Healed	Hair	Leucoderma	Venules	Nodule Small	Nodule Large
7·0	5 d. 9½ h.	2 h.	—	—	—	—	—	—	No permanent alteration			66	
	10 d. 19 h.	4 h.	24	57	45	—	—	—	None	—	—		73
24·0	2½ h.	1 h.	5	—	—	—	—	—	No permanent alteration			N.P.	
	5 h.	2 h.	—	—	—	—	—	—	No permanent alteration			35	
	10 h.	4 h.	3	—	19	48	—	+	None	—	—	61	
	15 h.	6 h.	5	26	—	32	39	+	None	—	—	54	
	30 h.	12 h.	2	15	—	29	31	+	None	—	—	46	
Radium emanation													
32·9	14½ h.	1 h.	7	—	—	25	—	42	No permanent alteration			46	
70·0	10 h.	1½ h.	1	26	—	29	33	50	None	—	—		60
94·5	10 h.	2 h.	2	—	—	20	36	48	None	+	—	52	
83·2	23½ h.	4 h.	2	—	—	19	27	47	None	+	+		52
58·0	2 d. 9 h.	6 h.	1	—	—	17	28	59	None	+	+		66
56·3	* 17 h.	2 h.	1	—	—	26	33	60	None	+	+		61
70·0	* 28½ h.	4 h.	—	21	—	27	34	61	None	+	+	69	
47·7	† 2 d. 21 h.	4 h.	—	19	—	25	32	60	None	+	+	60	

Area of 7 mg. capsule and emanation capsule, 3·14 sq. cm.
Area of 24 mg. capsule and emanation capsule, 0·5 sq. cm.
Screen, 1 mm. of lead, 1 layer of lint.
* Screen, 1 mm. lead, 0·3 mm. aluminium, 1 mm. paper, 1 layer of lint.
† Screen, 3 mm. lead, 0·3 mm. aluminium, 1 mm. paper, 1 layer of lint.
N.P. signifies "nodule persists."

DOSAGE STUDY No. 3.

"*Comparison of the Effects of Gamma Rays over a Wide Range of Intensity of Radiation.*"—A capsule covered by 1 mm. of lead emits mainly gamma rays; while it is true that there are beta rays of sufficient penetrating power to go through this thickness of lead, such rays form a very small percentage of the beta rays, and, in fact, of the effects to which the screened radiation gives rise ; the secondary radiation emitted by the lead, due to the passage of gamma rays through it, is of a soft type, and is cut out by a few layers of stiff paper and lint.

For this series three capsules were used, the 7 mg. and 24 mg. ones already mentioned, with the addition of a third one of just the same dimensions as the 7 mg. one, but filled with radium emanation. As in previous studies, the exposures were all based upon the unscreened radiation series with the 7 mg. capsule: covering this capsule with 1 mm. of lead necessitates increasing the exposure from two hours to about five and a half days, in order that the top layer of the skin shall actually absorb the same amount of energy. Such an exposure, *vide* Table III, is just as effective in causing the disappearance of the nodules as the shorter exposure to unscreened rays, but in an exactly analogous manner to that detailed in Study No. 1 ; the effect upon the skin is much less. When the quantity of radiation is increased so that the

TABLE IV.

Quantity of radium emanation, equivalent milligrams	Time in minutes	Equivalent	DAYS REQUIRED FOR REACTION									
			Erythema	Scaliness	Pigmentation	Exudate	Moist surface	Healed	Hair	Leucoderma	Venules	Nodule
84·00	5·7	1 h.	1	19	—	—	—	—	—	—	—	N.P.
35·00	13·5	1 h.	1	—	25	31	—	48	—	—	—	N.P.
17·40	27·5	1 h.	1	38	56	—	—	—	—	—	—	N.P.
6·80	71·0	1 h.	23	40	33	—	—	—	—	—	—	N.P.
84·00	11·4	2 h.	1	—	—	23	—	43	—	—	—	49
35·00	27·0	2 h.	1	18	—	42	—	49	—	—	—	49
17·00	55·0	2 h.	1	28	—	32	—	54	—	—	—	54
6·80	142·0	2 h.	5	17	—	37	43	50	—	—	—	50
1·12	900·0	2 h.	2	26	32	—	—	39	—	—	—	N.P.
84·00	22·8	4 h.	1	19	—	23	—	37	—	—	—	19
35·00	54·0	4 h.	1	—	—	18	—	36	—	—	—	42
17·40	110·0	4 h.	1	10	—	22	—	30	—	—	—	30
5·60	345·0	4 h.	4	—	—	22	26	39	—	—	—	39
1·60	1,380·0	4 h.	4	—	—	—	22	41	—	—	—	41

Area of capsule, 3·14 sq. cm.
Screen < 0·1 mm. silver, 1 layer of lint.
N.P. signifies "nodule persists."

exposures are a matter of hours, *vide* 94·5 mg. acting for ten hours (this being equivalent to 7 mg. unscreened for two hours), the effects upon the skin are not less, but rather more pronounced when gamma rays are used than when unscreened radiation is employed. The reason for this is probably not far to seek; a reference to the diagram, Fig. 3, shows that when surface equality of beta and gamma rays is established, the layer at a depth of 5 mm. will be actually absorbing about nine times as much gamma ray energy as that of beta + gamma type. This enhanced reaction obtained with the gamma rays is well seen with an exposure equivalent to one hour. With gamma rays (quantity 32·9 mg., acting for fourteen and a half hours) a typical exudate was produced and the subcutaneous nodule disappeared. Unscreened rays for one hour produced no such effect (*vide* Table I).

DOSAGE STUDY NO. 4.

"*Comparison of the Effect of Unscreened* (*Beta and Gamma*) *Rays upon the Skin and Subcutaneous Nodules, over a Wide Range of Intensity of Radiation.*"—A capsule of the same size as the 7 mg. capsule was filled with radium emanation and a series of applications made to the nodules. As the emanation decayed, further applications were made, and a series was completed in which the quantity of radiation varied from that equivalent to 84 mg. radium bromide to as small a quantity as 1·12 mg. In this way, data were obtained both of the skin and nodule reactions; they are grouped together in Table IV, and as before, the basis of exposure was made upon the one, two and four hours observations with the 7 mg. capsule. The general trend of the results is to confirm those which figure in Studies 1, 2 and 3. The times taken for the different phases of the skin reaction to appear do not vary very much with the dose administered, but the degree of such reaction does. Again, when a small quantity of radiation is administered for a long time, there is far less disturbance of the skin than occurs with a large quantity applied for a short time. We have not been able to apply a larger intensity of unscreened rays than 84 mg. over an area of 3·14 sq. cm.—*i.e.*, 23·6 mg. per sq. cm. With an exposure of 11·4 minutes to such radiation the skin became blistered, and an exudate appeared in about three weeks which soon healed.

It is a matter for further experiment to decide whether, if ten times as intense a source were applied for 1·14 minutes, there would be produced an equivalent reaction. We are not aware of any data dealing with such very intense sources of radiation.

DISCUSSION OF RESULTS.

There are two facts which have been established as a result of this study upon dosage:—

The first is that if the skin be irradiated in such a manner that neighbouring portions absorb the same amount of beta ray and of gamma ray energy, then the reactions are of the same kind, but they are generally of a more pronounced degree with gamma rays. This latter is probably to be explained by the fact that when the adjustment is made so that the surface layer absorbs the same amount of the two kinds of rays, the layers at a depth and which contribute to the reaction absorb more gamma rays than beta rays.

The second fact is, that if the skin be exposed to a large quantity of radiation (beta rays or gamma rays) for a short time, a much more pronounced reaction is observed than if the same dose be so administered that the quantity is small and the time correspondingly prolonged.

The effects observed upon the malignant subcutaneous nodules, however, is not appreciably different in the two cases.

In endeavouring to find some explanation of these findings, it may be useful to state the experimental conditions in another way. If we look upon the radiation employed as an irritant, then it appears that the skin is able to cope with such an irritant, provided it be not too intense, so that when a weak source is employed over a long interval of time the changes observed in the skin are very slight; the action of the irritant is counteracted by some defensive powers of the cells of the skin; in the tumour cells, however, this is not the case within the limits of our experimental range of dosage. It appears not improbable that the different effects to which the same amount of radiant energy can give rise, even in the same variety of cells (for instance those forming the skin), according to whether such radiation be employed over a short or a long time, are very intimately bound up with the series of changes which form the cycle of the cells' life—viz., growth to maturity, division and growth once more.

It has been shown by several observers that the stage of cell life represented by division is an especially vulnerable one to radiation. Mottram has shown that the ova of *Ascaris megalocephala* are about ten times as vulnerable when in the dividing stage as in the growing stage. Such a factor we may term the "factor of vulnerability;" in view of such a finding and the possibility that it applies also in the case of malignant cells, it appears a desideratum in the clinical application of radium that in the process of irradiation all the cells of the tumour should be in the dividing stage, for in that case they would be irradiated when they were at the condition of maximum vulnerability. The difficulty of obtaining such a condition of things is the comparatively long time it takes for such cells to complete the cycle of their life. For example, a rapidly growing sarcoma of the rat, which we have had under observation for five years, goes through the whole cycle in about four days, say one hundred hours, and the division time is about one hour. This is rather a rapidly growing tumour, yet even in this case it is seen that an exposure lasting four days would be necessary in order that all the cells should receive irradiation during the phase of division.

From a general consideration of the problem, it will appear that unless the "factor of vulnerability" be something comparable with the ratio of the times, which represent the two main stages of cell life (viz., growth and division), then little advantage is gained by prolonged exposure, except in so far as skin reactions are concerned. Hence it follows that in most cases, the main consideration is that the "growing" cells should receive a dose of radiation which is sufficient to prevent their reaching the dividing stage; such a dose should be more than enough to arrest the process of division in those cells which were in this stage at the time of irradiation.

We have pleasure in recording our thanks to the Radium Institute for kindness in giving us large quantities of radium emanation, upon several occasions, for the purposes of this investigation.

REPORT OF SOCIETY.

RÖNTGEN SOCIETY.

X RAYS AND THE WAR.

Presidential Address to Röntgen Society by Capt. G. W. C. Kaye, M.A., D.Sc., on November 6th, 1917.

There was once a time in my salad days when, having suffered several addresses at the hands of various presidents—I hasten to add not of this Society—I vowed to myself that if for my sins I ever became President of a learned Society, the last thing I would do would be to inflict an address on a long-suffering audience which had just done its best to offer one a signal compliment. But, as the little girl said the first time she saw a picture of a giraffe, "It's too good to be true;" and I can only say in extenuation that time has weakened my resolution and circumstances have modified my views.

I am very sensible of, and grateful for, the high honour you have paid me, and I trust that my year of office will be no less profitable to the Society than those of my distinguished predecessors. With your support I hope for a stimulating session, despite the troubled nature of the times.

We have sorrowfully to record the death of Mr. Wilson Noble, the third President of this Society. He was greatly esteemed, both as a distinguished radiologist and as a man.

The Society also mourns the loss of Mr. Duddell, Past President and a Vice-President up to his death. A scientist of the first rank, and a man of engaging personality, his death will be acutely felt by the members of the Society.

There are very few societies in which the general *cammaradie* is so pronounced as in the Röntgen Society, and I know of no other society whose meetings one is almost invariably able to leave with the feeling of having spent a most profitable and, sometimes, amusing evening.

This good fellowship has, I gather, always been a feature from the early days, when this, the first of all Röntgen Societies, was founded. The formal inauguration of the Society took place at St. Martin's Town Hall on November 5th, 1897, so that to-night we celebrate, within a day, the twentieth anniversary of our birth. I am glad to be able to announce that the Council has decided to-night to commemorate our first President by endowing an annual lecture, to be called the Silvanus Thompson Memorial Lecture. This will be given before the Society, and an eminent scientist, either from this country or abroad, will be invited to deliver the lecture each year.

At the first meeting there was a large and distinguished audience, and the late Professor Silvanus Thompson gave the new Society a splendid send-off with a brilliant Presidential Address. Then, as now, the constitution of the Officers and Council was half medical men and half scientific laymen, In the early days scarcely any medical men possessed the necessary apparatus for generating X rays, and they had to turn to their scientific friends for help and co-operation. The union of forces was productive of the happiest results, and the co-operàtion has continued, and will, I trust, continue for all time. Both sections of the Society will, I am sure, acknowledge the stimulus and help which each has derived from the joint association; and the great majority of medical radiologists are only too ready to give the physicist the recognition which is his due, not only for past work but in the work to come from future co-operation.

It would, I think, be all to the good if a more thorough study of the X rays formed part of the physics course of the medical student working for the first M.B. I have had a good deal to do with examining medical students in physics and have learnt much from them on subjects not altogether connected with physics. Some of them surprise you at times with the wealth of their knowledge. I remember once setting a question on Ohm's law and got the answer from a budding medico that "Ohm was a Royal Engineer Officer employed by the Board of Trade, who, having one day discovered a law, persuaded the Government to put it into force."

It was close on two years before the first formal meeting that Röntgen had stumbled, so to speak, across a new type of radiation, the wonderful properties of which excited the whole civilised world. Since then the art of radiography has gradually extended into fields once never dreamt of. A present-day development, very typical of the times, is the detection of contraband metals, the examination of autogenous welds, and the scrutinising of steel and other metal castings and plates for faults and blow-holes. Such work demands high voltages and the heaviest outputs. Already steel plates over one inch thick have been successfully examined. Some lantern slides illustrating this work, which promises to be of great war importance, will be shown to the Society by M. Pilon later in the evening.

But the all-important use of the X rays, and the one dominant in our minds to-night, is their medical application. Every hospital of any size now has its X-ray department, and there are many thousands of radiologists—both medical and laymen—devoting their lives to the work.

X-ray technique has improved so vastly as to give the diagnostic methods of physician and surgeon a facility and exactitude never deemed possible at one time.

In the large military hospitals the great majority of wounded soldiers are X-rayed—they all ought to be, but unfortunately it is not always possible.

The X-ray examination of wounds and injuries has become routine practice, whether in the field, by the use of the ingenious and cleverly designed motor-lorry outfits, or in the base hospitals. The X-ray is as indispensable as the dressing or the splint, and it is an essential adjunct in prescribing and directing, as well as avoiding operations. Even sprains are radiographed to find whether there is any slight bone fracture—as there very often is.

The X-ray detection of embedded bullet and shell fragments is now so certain as to be commonplace. Bullets and shrapnel are found and removed from any part of the body, even from the lung and brain, or in the region of the heart. Precise instruments for localisation in the operating theatre are now in use, and even during the operation itself the surgeon's instrument may be guided to the foreign body. Stereoscopic fluoroscopy is possible, and if a practical apparatus could be produced it would be of incalculable value to the surgeon and radiologist in their combined efforts.

Unless there is a suspicion of septic poisoning a bullet is generally best left alone, but shell fragments are usually dirty, and the nature of the damage they inflict along their course makes it important that their exact position should be known.

It is in such cases that X-ray stereoscopy attains its fullest delicacy. For example, the location of small foreign bodies near the eye, or actually in the eyeball, can be carried out to the hundredth of an inch.

In the case of a fracture the stereoscopic radiograph reveals the direction of the fracture and the disposition of the broken bone, and so assists the surgeon in deciding on the method of reparation. After the bone has been set the progress of the recovery can be clearly followed in the subsequent photographs—whether the parts are joining up, whether new material is forming. The sequence of radiographs is included in the record of each case. The total number of photographs already taken at the various hospitals since the war commenced amount to many hundreds of thousands. Very valuable data will be obtained when time allows the radiologist to go carefully over all the accumulated records of cases.

The value of the X rays in diagnosing chest complaints has been established again and again in this war. This is the case particularly with incipient tuberculosis, where early diagnosis is of great importance. Not only the diagnosis but the treatment of tubercular glands has been attended with considerable success.

Great attention has been paid in this war to the soldier's teeth, and very rightly. Here, again, the X rays are playing their part, and dental radiology has become an important subject.

I can do no more than mention the splendid work of "opacity" radiology, which can diagnose with routine certainty diseases of all parts of the alimentary canal. This, again, has been of great service in examining army recruits of doubtful medical fitness.

A word should be said of the invaluable results obtained from shortening exposures, especially in heart and lung conditions. First class radiographs, using exposures from $\frac{1}{100}$th to $\frac{1}{500}$th second, can be obtained.

Another war development of radiology is its employment by the orthopædic surgeon in his efforts to restore damaged limbs.

But the beneficent effects of the X rays do not end with radiography. They have achieved wonderful results, not only in the diagnosis but in the repair of wounds. Amongst the minor tragedies of the war, few are more pathetic than the ghastly mutilations and disfigurements caused by shell wounds of the face and head. Many of our soldiers would seem to be doomed to a life of perpetual misery and humiliation, but by the wonderful plastic operations of the surgeon they can be restored to at least a semblance of their former selves.

The radiologist's part in such work is to render scar-tissues pliant, to depilate hair from the scalp and skin surfaces concerned, to render the transferred flaps of skin pliant and more adaptable to their new positions, and to stimulate generally the healing process in both flaps and bone. For these purposes he employs radiation treatment, either X rays or radium rays.

In the treatment of septic wounds and persistent sinuses, the most extraordinary success has resulted from a combination of X rays and ultra violet rays. Hyperthyroidism or "soldier's heart" has been successfully treated by X rays and radium rays.

The electrotherapeutist has also been prominent in war work. Countless electrical departments have been established in military hospitals throughout the country for the treatment of war injuries. Quite one half, if not more, are gun-shot wounds of the nerves with paralysis of the muscles. These cases are sent for electrical examination of the injured nerves and subsequent electrical treatment.

Many cases of war wounds, more particularly those of the uncomplicated but inert type which refuse to heal, are treated electrically. Simple application of a direct current stimulates the process of repair and sluggish wounds at once begin to heal.

"Trench feet," which occurred in large numbers last winter, receive benefit by electrical treatment.

Cases of shell-shock and neurasthenia and other functional disorders of the nervous system, some of which are seldom or never seen in times of peace, are now being cured in large numbers by electrical treatment.

And so the story goes on. And has not the radiotherapeutist found his reward in the gratitude of many men to whom he has once more made life endurable?

The outbreak of the war found the X-ray manufacturers, like everybody else, quite unprepared. The greatest credit is due to them for the splendid way they threw themselves into the breach and turned out, in record time, unprecedented numbers of outfits for the Army. The X-ray bulb manufacturer was at once confronted with the absence of the glass, which Germany had hitherto supplied. The English glass manufacturer had to face the task of producing a uniformly good glass which would stand up, without puncturing, to the high voltages which obtain in practice. The problem was very difficult, but is gradually being surmounted by State aid. In the meantime our American and French friends came to the rescue.

It is remarkable how slight have been the changes in design experienced by the target tube, introduced in 1896 by Sir Herbert Jackson. He would be a bold man, nevertheless, who would assert that the present design has approached finality. All X-ray tubes are, in fact, extraordinarily inefficient things. Under favourable conditions they make use of rather less than one part in one thousand of the energy imparted to the cathode rays.

The Coolidge tube, first introduced nearly four years ago, has been considerably improved in detail and now claims pride of place among X-ray tubes. It is not entirely free from defect, and its rays are no more homogeneous than those from an ordinary bulb, but its elasticity, precision, ease of control, long life, and relative freedom from inverse current make it an invaluable addition to the radiologist's equipment.

Some wonderful output figures have been obtained by Coolidge on experimental water-cooled models. One tube was run continuously for many hours at 200 milliamperes and 70,000 volts, the power input being 14 kilowatts, *i.e.*, about 19 h.p. It is anticipated that this figure will be shortly increased to 50 kilowatts. It was hoped on its introduction that the Coolidge tube would be the means whereby X rays approximating to the hardest gamma rays from radium would be obtainable. Such anticipations have not been realised. In some recently published work, Sir E. Rutherford describes measurements on the very hardest rays emitted by a Coolidge tube excited by close on 200,000 volts. In order to filter out the hardest rays present, he passed them through 1 cm. of lead, the reduction in intensity being over a million fold. The residual rays proved to have a wave length of about 0·06 Å.U., which may be compared with Rutherford's latest estimate of the wave length of the hardest gamma rays from Radium C—between 0·02 and 0·007 Å.U. In other words the Ra. gamma rays in question correspond to X rays generated by voltages between 600,000 and 2,000,000—figures to which no X-ray tube of present-day design could possibly stand up, even if we had the means to produce such voltages on a practical scale.

As to the composition of the X rays generated by an X-ray bulb, we know now that the rays consist in general of two groups:—

(*a*) A continuous spectrum of rays with a sharply defined boundary on the side of shorter wave lengths, the position of such boundary depending on the voltage on the tube.

(*b*) One or more characteristic radiations (J, K, L, M series) each approximately homogeneous and characteristic of the metal of the anticathode. The higher the atomic weight the more penetrating the radiation in the same series.

The proportions of (*a*) and (*b*) depend entirely on the conditions. With very soft tubes a large proportion of the radiation may be wholly characteristic.

With reference to the spectrum of general rays, one positive fact emerges. It has recently been shown that the maximum frequency (or hardness) of X-ray which a tube can yield can be readily calculated by a simple extension of Planck's quantum theory. The relation in question (due to Einstein) is

$$Ve = h\nu$$

Where V is the voltage on the tube,
e the elementary charge on each cathode ray,
ν the frequency of the hardest X-ray produced,
h is a universal constant.

E and h are known with considerable exactness, so that we have the means of calculating very readily the wave length of the hardest X-ray generated by a given voltage on a tube, or *vice versa*, the voltage necessary to generate a particular X-ray.

Inserting Millikan's latest values of these constants, we have

$$\text{Wave length in Å.U.} = \frac{12{,}400}{\text{voltage.}}$$

The accuracy of this simple relation has been confirmed experimentally over a wide range of voltages in America. It will be noticed that the result is independent of the material of the anticathode.

With reference to the characteristic radiations, each consists of a number of spectral lines. For these, Einstein's simple law does not hold, a greater voltage being required to generate the radiation. Webster noticed that the various spectral lines of a series all spring into being together as the voltage is increased through the critical value.

Through the medium of the X rays we have unveiled a few of the secrets of the structure of the atom. The biggest development has resulted from the discovery of the wave-like character of the X rays. It was Laue and his pupils, in 1913, who first demonstrated the diffraction of X rays by crystals, but it was in this country that the first real insight into the problem came.

The Braggs showed how the crystal reflection of X rays could be utilised to separate out different waves in a fashion exactly analogous to the production of colours by thin plates. The X-ray spectrometer revealed both the atomic spacings of a large number of crystals and the absolute wave lengths of a variety of monochromatic X rays.

The work of Moseley stands out pre-eminently here. It is a sad comment on the ill-preparedness of this country for war that it allowed so brilliant a scientist to go out as a combatant officer to Gallipoli to meet an untimely end. Moseley, working at Manchester and Oxford, had photographed many characteristic X-ray spectra and measured the wave lengths of the principal lines. He was able at once to obtain the very remarkable and simple relation, now associated with his name, namely, that the frequency of a characteristic X-ray from any element is proportional to the square of the atomic number of the element.

This atomic number must be distinguished from the atomic weight. It denotes merely the order in which the elements come when arranged according to their atomic weights. Thus the atomic number of hydrogen is 1, of helium 2, of lithium 3, and so on. The atomic numbers follow the order of atomic weights, except in three instances; argon and potassium, cobalt and nickel, iodine and tellurium are interchanged.

The X-ray spectra are revealed as an extreme type of light-ray spectra, and are even more characteristic of the parent atom. Later work has shown that X-ray spectra contain many lines and are much more complicated than was first believed.

Moseley's work has been extended by others, notably by Siegbahn and Friman. We now know the atomic numbers of all the known elements, beginning with hydrogen and ending with uranium—with an atomic number of 92. Each of the atomic numbers is represented by an element, with the exception of numbers 43, 61, 75, 85 and 87, which stand for five elements waiting to be discovered.

It by no means follows, however, that there are only five missing elements; five is a lower limit, for we now know that several elements may have the same atomic number. Such isotopes, as Soddy has called them, cannot be distinguished one from another by ordinary chemical or physical tests. They are grouped together under the one atomic number in the periodic classification of the elements, but, nevertheless, they may, and do possess atomic weights differing by several units.

It is apparent that the atomic number is something more than a mere integer; it undoubtedly represents some fundamental attribute of the atom. Now the work of Rutherford and others makes it a practical certainty that the atomic number equals the excess number of positive charges in the nucleus of the atom.

We are led to the views of a school of thought which no longer regards the atomic weight as a constant of an element, but holds that an element is defined more characteristically by features depending on the nucleus of the atom rather than on the atom itself. On this view then, there are only 92 elements though many more kinds of atoms, and isotopes should be regarded as varieties of one and the same element, some varieties consisting wholly of atoms of the same weight, others consisting of atoms of different weights.

The boundaries of the spectrum have been widely extended since the war broke out. In the ultra-violet, Lyman has extended the region first investigated by Schumann to a wave length of about 500 Ångström units, and Richardson and Bazzoni have very recently further extended this to 420 Å.U. The longest X-ray so far measured by Siegbahn has a wave length of 12 Ångström units. Rutherford has recently given evidence for believing that the wave length of the hardest gamma rays from Ra. C is in the region of $\frac{1}{100}$ Å.U. We are thus now familiar with a range of over ten octaves of X and gamma rays without a break—not at all a bad record for so young a subject. There still remain about five octaves to be explored in the region between X and ultra-violet rays, a region which contains the characteristic X rays of the light elements from hydrogen to neon.

And now to turn to quite a different topic. At the moment we are all reproaching ourselves for our past neglect of science in this country, for we are paying the penalty of our indifference, despite the wonderful adaptability and resource which this war has shown we possess as a nation.

The country is slowly learning its lesson. Willy-nilly, we are being led to see at last that our system of education misdirects much genius into unproductive channels, and we are awakening to the importance of research both pure and applied.

The value of applied science to industry is now accepted throughout the country, and British industry should begin to feel the benefit, especially now that the principle of State-aided research is established.

But in the midst of our new-found appreciation of applied research, I would wish to add my voice to those who are also urging the claims of pure research. This is not so much for the present time as for the days of peace to come, for unless it has an immediate bearing on some war or national problem, speculative research should rightly stand aside till the war is over.

But when it is no longer a question of "needs must" we must not forget that it is the pure academic research, unrestricted and unprescribed, which has been the prime cause of all the radical changes in industrial methods. Research in pure science is rarely appreciated by the general public or manufacturer, for it cannot be done to order; it is never possible to foresee the ramifications which an enquiry may assume. One must put faith in the research worker that he may continue to have faith in himself. Much of what he will do will be discontinuous and abortive, but he must not be hampered by utilitarian notions being continually rammed down his throat. If he does not solve the original problem he will probably solve some other which has sprung from it, and one successful discovery may outweigh by far all his failures.

I do not for one moment lose sight of the equal importance of the applied research worker, who is responsible for turning to account the discoveries of the pure scientist. There is, in fact, no line of demarcation between the two divisions of research. Each involves study, hard work, and thought. The methods of both branches are questioning and searching; the common end is knowledge, to which there is no heaven-sent road.

And what has been the reward of the research worker in the past? It is the shameful truth that we have done our best to starve him. The man of science, with few exceptions, has received little or no recognition by the mass of the people of this country, who, unknowing and uncaring, have been perfectly content to allow him the status, both social and financial, which he himself has modestly sought for his every-day life and wants.

But every dog has his day, and the country in its hour of need has turned to its scientific sons for help in its war problems, and has not turned in vain. The war is bringing home to the nation the dependence of its very existence on science; and a little good may come out of a very great evil if public opinion can be brought to realise that the statement is as true in peace as in war, and that a nation's administrators should always include among them suitable men of the highest technical and scientific standing, not merely to advise but also to initiate and direct.

NEW INSTRUMENTS AND TECHNIQUE.

AN AUXILIARY SWITCH-BOARD AS AN AID TO SHORT EXPOSURES.

By Harold C. Gage.

Radiologist to the American Red Cross Hospital of Paris, Chief of the Röntgen Service, Hospital Militaire VR 76, Ris-Orangis, and Complementary Hospitals.

A large number of hospitals are equipped with their own electric lighting plant and are far removed from electric mains, and are not provided with accumulators. This condition often places the X-ray department at a disadvantage for making short exposures so necessary in chest and kidney work, the reason being that hardly ever is a compound wound dynamo installed, but a series or shunt type which, although perfectly satisfactory for lighting, will not respond to an instantaneous call of the necessary current without a heavy fall in voltage, and by the time that the engineer or automatic regulator has been able to speed up to the demand, the radiographer's opportunity has passed.

Being similarly situated at one time, and explaining to an assistant why we were unable to use the intensive switch and small self-induction on our apparatus, I happened to say that if the department had the control of the house lighting switch and could simultaneously switch out the house light and divert the current to our coil our difficulty would in a measure be solved. It was actually solved in the simple switch-board below. Fixed by the side of the X-ray installation, conveniently placed, so that the switching off of the lights and closing of primary switch could be easily done. I found that the demand of the small self-induction was 30 amp. A board was made for me by Maison Gaiffe, of Paris, with 24-50 C.P. carbon lamps in parallel, with separate switches to each four lamps to gradually switch them in, the supply being connected to the arrival supply to the X-ray plant. To design a board suitable for any given installation it is necessary to know the demand made upon the main when operating the low self-inductance of the coil, and to put in the number of lamps required; four 50 C.P. carbon 110 V. consume about 5 amps. So it is easy to determine the number of lamps necessary.

In all installations of this kind it is necessary to fix a protection condenser to the dynamo.

The accompanying diagram will illustrate the connection for the switch-board.

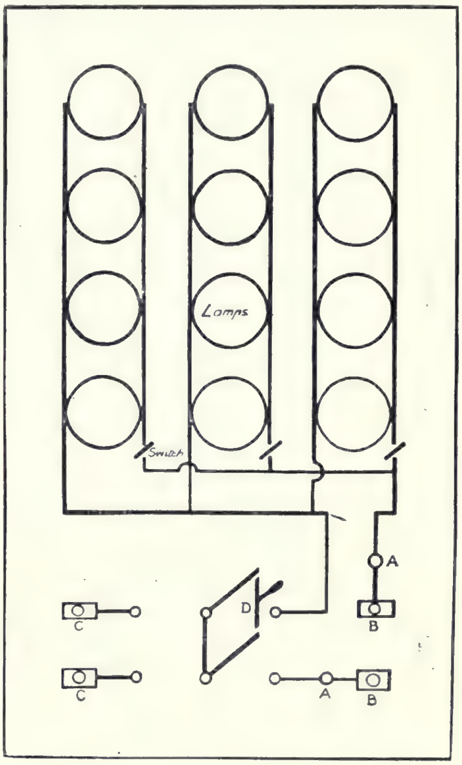

Illustration I.

Wiring of the Switch-Board for 15 amps.

B.B. Main terminals connected to arrival terminals of main to X-ray installation.

A.A. Fuses.

D. Double pole knife switch.

C.C. Connection to primary closing switch of control of X-ray installation.

To operate, throw in knife switch *d* to the right, and the first small switch to first four lamps. Watch voltmeter for rise in voltage after the drop, repeat with the successive switches. When all are in, throw knife switch *d* over to the left, which is the same as putting in the primary switch to coil; give the necessary exposure, and throw back to the right.

If not further needed, cut off gradually by smaller switches.

It is advantageous to mount a voltmeter, should there not be one already mounted, so as to check the rise and fall in pressure.

Illustration II.

Shows the installation and general connection complete.

On the left will be seen the lamp board.

— Connection on the right to main.

-̇- Connection on the left to primary.

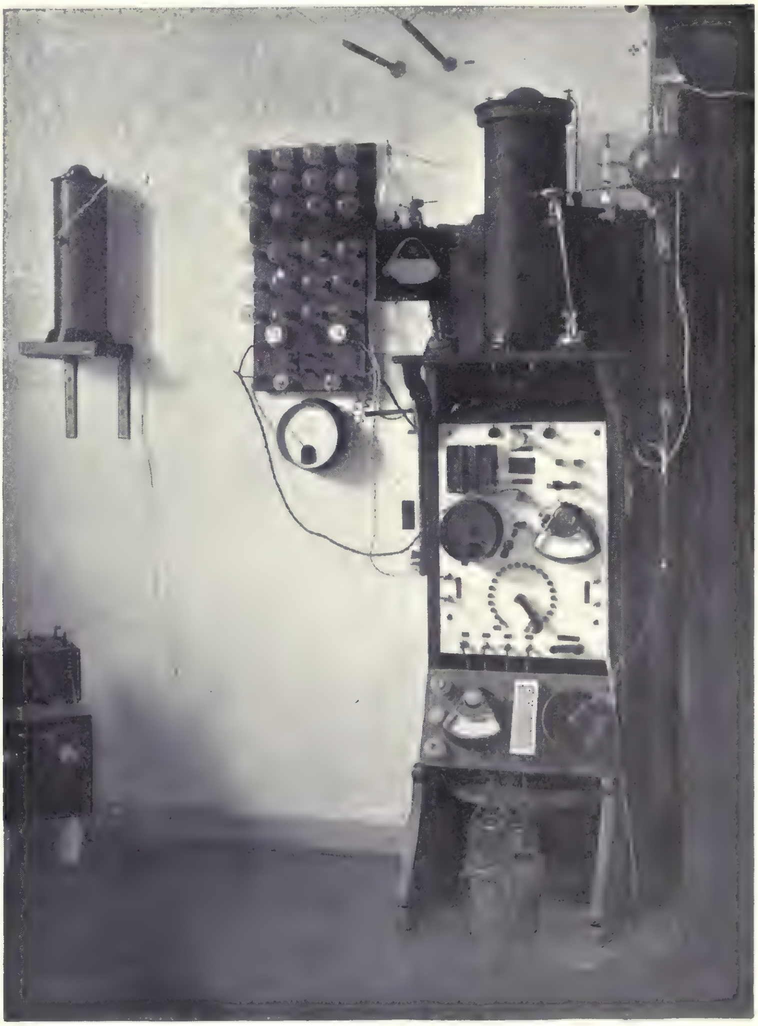

Illustration II.

NOTES AND ABSTRACTS.

RADIO-DIAGNOSIS.

Some Practical Points on the Interpretation of Accessory Sinus and Mastoid Plates. —F. M. Law (*American Journal of Roentgenology*, August, 1917, p. 398).—This observer points out the importance of noting in the lateral plate of frontal sinuses whether the anterior wall is thick or thin and of uniform density. This makes a difference in the density of the shadow of the sinus in the antero-posterior view. Dense polypoid material, or tumour, causes a diminution of the shadow of the frontal sinuses and antra in the lateral view, while simple pus causes very little change.

The presence or absence of supra-orbital cells is of importance if operation is decided upon, and likewise the presence of a cell in the crista galli may be the cause of persistence of the trouble after a frontal sinus operation.

The view of the sphenoidal sinuses, taken in the vertical position, shows the presence or absence of a large ethmoid cell, a perisphenoid cell, which sometimes lies adjacent to the sphenoid, and is the cause of some obscure sinus conditions. The lateral plate may show a cloudy appearance of the sphenoid sinuses, whereas the vertical plate will show this shadow to be due to a large opaque ethmoid cell adjacent to the sphenoid, while the sphenoids are clear.

In the examination of the mastoid region, the bone in children is more transparent, and will require less pathological change to produce the same degree of cloudiness as in adults where the cortex is hard. The appearance of the lateral sinus is often a good diagnostic point. In the normal pneumatic mastoid the sinus does not show well, only the anterior border of the groove being visible, but any increase in the density of the cells will bring out the outline of the sinus. If the mastoid is completely broken down and the sinus exposed and covered with granulations, no indication of the sinus will be seen, and the whole mastoid area will show as a blur.

The size of the cells plays an important part in prognosis. A large pneumatic mastoid with large antrum cells is more liable to clear up without operation than one with small cells. The latter are more liable to clog and stop drainage; this is the reason why so many cases clear up without operation.

The author advises the examination of cases post-operatively. Many cases which have been operated on, and which have not properly cleared up, will reveal cells remaining in the mastoid process. These contain granulations which keep up the discharge and prevent healing. R. W. A. S.

The Roentgen Diagnosis of Polypi of the Maxillary Sinuses.—C. A. Waters and H. P. Doub (*American Journal of Roentgenology*, September, 1917, p. 470).—The authors record seven cases of polypi and mucoceles in the maxillary antrum which were confirmed by operation.

The radiographic appearances are well illustrated, and it is stated that polypi and mucoceles cannot be differentiated on the plate. R. W. A. S.

Left-sided Cæcum and Ascending Colon, with Absence of Transverse Colon.—C. E. Corlette (*Medical Journal of Australia*, 30th June, 1917, p. 551).—This observer records a case, clinically showing dilatation of the stomach and constipation, and which on X-ray examination showed the cæcum and ascending colon to be on the left side of mid line. The ascending colon ran almost vertically up to the splenic flexure giving the appearance of absence of the transverse colon.

R. W. A. S.

On the Occurrence of Fractures.—J. G. Edwards (*Medical Journal of Australia*, 14th July, 1917, p. 25).—This observer publishes in tabulated form an analysis of 6,700 cases of fracture of all parts of the body which, with the exception of about two-thirds of the fractures of the cranial bones, nasal bones, and ribs, have been confirmed by radiography.

Fractures of the upper extremity, he finds, account for over 50 per cent. of all fractures, while the most common fracture of all is at the lower third of radius. R. W. A. S.

Chronic Ulcer of Stomach and Duodenum: Surgical Treatment and End Results.—H. B. Devine (*Medical Journal of Australia*, 4th August, 1917, p. 89).—The author in presenting his results in a series of cases of chronic ulcer of the stomach and first part of duodenum, lays great emphasis on the help which can be afforded by a proper radiographic examination.

Discussing it as an aid in pre-operative diagnosis, he states that minor degrees of pyloric stenosis cannot always be diagnosed at the operation, whereas they are quite obvious on the screen. He has seen stomachs on the screen so dilated that they filled a large part of the abdomen. While at operation he found them contracted and retracted, so that the extreme dilatation and its significance would not have been fully appreciated. The greater part of the dilatation and hypertrophy of a diseased stomach takes place at the fundus. This retracts after a careful preparation for operation, and the retracted fundus can be drawn down at the operation, from under the left thorax, like a piece of elastic.

The author finds it necessary, in the treatment of a certain class of chronic ulcer by resection, to distinguish between the minor degrees of organic pyloric stenosis and pyloric spasm. An alkaline and, after an interval of several days, an ordinary barium meal is given. The difference, or agreement, of the emptying times indicates the nature of the pyloric lesion.

The question of a two-stage partial gastrectomy is often, he thinks, best decided after a screen and a clinical examination.

He was present at a post-mortem examination of a patient who had died from post-operative vomiting following an iso-peristaltic gastro-enterostomy. A hugely dilated and hypertrophied stomach had retracted so much that the situation and direction of the stoma had changed, and the jejunum had angulated at the site of the anastomosis. Since then, he always considers in a screen examination where the stoma should be placed and the length of the jejunal loop.

If an ulcer can be seen on the screen it is chronic and penetrating, and needs resection. Where the diagnosis of an ulcer depends entirely on the recognition of a spasm of the circular muscle and delayed emptying time, the ulcer may be superficial, recent, or small, and if the situation is favourable, gastro-enterostomy may suffice. To be surgical, an ulcer of this type should have failed to respond to medical treatment.

The radiographic evidence, confirmed by operation, in his series of cases was as follows:—

(1) In seven cases the ulcer at the lesser curvature could be clearly seen as a crescent-shaped bismuth shadow niche, associated often with a light air spot and a spasm of the circular muscle in the vicinity of the ulcer. The emptying time was prolonged.

(2) In three cases the ulcer, as above, was associated with organic hour-glass stenosis.

(3) Two cases showed a very dilated and hypertrophied stomach, which nearly filled the patient's abdomen. This was secondary to duodenal stenosis following duodenal ulcer. Such extreme dilatation is rarely caused by malignant disease, and is generally due to ulcer. In cancer the patient dies before the stomach can become so dilated.

(4) In ten cases of chronic stenosing prepyloric ulcer, the dilatation was not as extreme as in the last group, and often on the screen the prepyloric part appeared to be amputated.

(5) Soft ulcers and erosions showed spasm of the circular muscle and delayed emptying time.

(6) There was an altered cap in three cases of duodenal ulcer.

The paper illustrates well the co-operation of the surgeon, pathologist and radiologist, and is all the more valuable as the cases came to operation and were followed up afterwards.

R. W. A. S.

DENTAL PATHOLOGY.

Dental Pathology: Its Importance as an Avenue of Infection.—F. D. Leach (*Amer. Jour. of Roentgenology*, Oct., 1917, p. 526).—It is nearly safe, the author says, to state that at least ninety per cent. of the root canals treated, and attempts made to fill these canals, have been followed by a destruction of the tissues of the apical space, either by infection or irritation due to the over-use of drugs and root-filling materials.

It has been the custom of some in the past, and is still advocated by many to-day, that it is perfectly good practice to use arsenic in the destruction of pulps of teeth, and in severe chronic and putrescent cases to force phenol, iodine, and other escharotics and irritating drugs through the root canal and into the apical space; also, the carrying of root-filling material into this space with the hope that the end of the root will be encapsulated, that the surrounding tissues will take kindly to the foreign body and obliterate the space by building in around it.

The author thinks that this practice is pernicious, and should be discouraged by the medical profession whenever an opportunity occurs.

R. W. A. S.

CORRESPONDENCE.

To the Editors of ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY.

SIRS,

In your issue for February last there appears the first portion of an address, by Dr. L. Erasmus Ellis, on "Some Modern Developments of Roentgenology."

Speaking of the risks of X-ray work, he says (p. 284), "The great danger one has to guard against is the setting up of a dermatitis, but the use of hard rays and effective filters obviates this to a large extent. Of the rays emanating from an active X-ray tube, the alpha, beta, and gamma rays are those most usually spoken of."

The speaker's mind must surely have strayed for the moment from the X-ray bulb to the radium tube, for while it is permissible, and even desirable, to speak of the non-particulate rays in both cases as *gamma* radiation, to speak of alpha and beta rays as "emanating from an X-ray tube" is not scientifically correct.

The cathode stream, consisting as it does of negative electrons, may be termed beta radiations, but it does not get to the outside of the roentgen bulb unless a special aluminium window is provided, as first demonstrated by Lenard. As to the alpha rays of radium—which are generally regarded as atoms of helium, certainly no such relatively large corpuscles "emanate" from it.

Dr. Ellis goes on to say that the alpha and beta rays can be cut off by a filter consisting of 2-3 mm. of aluminium. The aluminium filter is, as a matter of fact, used because the gamma radiation from a roentgen bulb—which is the only kind found outside the glass—is not homogeneous. Even the "hardest" tube gives out a certain proportion of soft rays, and it is to reduce these latter as near as may be to the vanishing point, without proportionately diminishing the hard rays, that filters are employed. It should be noted that a particulate or corpuscular radiation may be absolutely stopped by a filter adapted to its known range of penetration; whereas rays of the gamma (ether pulse) type will, at any rate in theory, appear to some extent on the distal side of any practicable filter. It is, however, possible to reduce them to a negligible quantity.

The above mentioned facts are, of course, well known to all expert radiologists, but in these days your journal is constantly attracting new readers who are taking up X-ray work for military purposes. The existence of such readers must be my excuse for calling attention to these elementary matters.

Yours faithfully,

F. HERNAMAN-JOHNSON.

61, Harley Street, W. 1.
March 3rd, 1918.

PUBLICATIONS RECEIVED.

Books.

Semiologia Röntgenológica del Aparato Respiratorio Intratorácico. By Dr. R. Torres Carreras.

Journals.

American Medicine, Jan., 1918.

American Journal of Electrotherapeutics and Radiology, Dec., 1917.

American Journal of Roentgenology, Dec., 1917.

American Medicine, Dec., 1917.

Archives de Electricité Médicale et de Physiothérapie, Jan., 1918.

Boston Medical and Surgical Journal, Jan. 17th, 24th, 31st, 1918.

British Journal of Dermatology and Syphilis, Oct.-Dec., 1917.

Bulletin of the Johns Hopkins Hospital, Jan., 1918.

Gaceta Médica Catalana, Jan. 31st, Feb. 15th, 1918.

Good Health, Aug., 1917.

Hospitalstidende, Oct. 24th, Nov. 7th, 14th, 28th, Dec. 6th, 12th, 19th, 1917; Jan. 17th, 23rd, 30th, Feb. 6th, 13th, 1918.

Journals—*continued.*

La Radiologia Medica, Jan.-Feb., 1918.

Maryland Medical Journal, Jan., 1918.

Medical Bulletin, Jan. 1918.

Medical Journal of Australia, Oct. 27th, 1917.

New York Medical Journal, Jan. 12th, 19th, 26th, Feb. 2nd, 1918.

New York State Journal of Medicine, Jan., 1918.

New Zealand Medical Journal, Dec., 1917.

Norsk Magazin for Lægevidenskaben, Feb., 1918.

Policlinico, Il., Dec. 16th, 1917; Feb. 1st, 1918.

Proceedings of the Royal Society of Medicine, Jan., 1918.

Revista Española de Electrologia y Radiologia Médicas, Nov., 1917.

Revista Médica de Málaga, Jan., 1918.

Southern Medical Journal, Jan., 1918.

Ugeskrift for Læger, Jan. 24th, 31st, Feb. 7th, 14th, 1918.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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THE THERAPEUTIC INFLUENCE OF X RAYS ON FEMALE PELVIC DISEASE.

An Introductory Address Delivered before the North London Medical Society, Dec. 13th, 1917.

By Sir John Phillips, M.A., M.D. (Cantab), F.R.C.P.,
Hon. Physician to Her Majesty Queen Mary,
Consulting Obstetric Physician, King's College Hospital, Emeritus Professor of Obstetrics in King's College.

Gentlemen,

On being honoured by your President with an invitation to introduce some gynæcological subject to your notice for discussion, I chose the one above for the following reasons :—(1) The comparatively recent development of this particular; (2) The existence of a definite percentage of cases which may be treated more satisfactorily by this method than by operation ; and (3) The opportunity it gives for comparison between the results of this method and those obtained by surgical means.

The discovery of the value of this treatment was apparently purely accidental. In 1903, a peculiar sterilizing effect on the testicles of rabbits was substantiated by Alberg-Schonberg. About two years afterwards, Halberstadter demonstrated a similar result in the female generative organs of animals. A few years later its effect on the generative organs of the human female was definitely proved. It was found after a deep application of certain doses of X rays that menstruation usually ceased, temporarily, or, as a rule, permanently, and that an artificial menopause ensued. Since that time abundant evidence has been collected to prove that we possess in X rays a most powerful remedial agent, and that therefore great care must be taken in dosage and administration.

The treatment was primarily extensively tried in bleeding myomata of the uterus and with markedly successful results; from that time until now its field of use has extended to other disease, to which I shall presently allude, but it has always been found to be chiefly beneficial in fibroids.

In applying these rays there is no doubt that two important principles should be laid down:—

(1) That an accurate diagnosis should be made of the condition present; and (2) that owing to the complexity of the process the treatment should be carried out by an expert under the supervision of a gynæcologist.

I have had the advantage of discussing the dosage and administration of X rays both with Dr. Ironside Bruce and Dr. Robert Knox, and have their permission to quote their individual methods briefly:—

Dr. Ironside Bruce says, "I arrange to give in the case of myoma the maximum of X-ray radiation. There are two factors which determine what is maximum.

"1. The skin. Even when using a filter, which in my practice is composed of several layers of thick felt, skin reaction is possible. The thickness of felt has been arrived at by gradual increase, watching the effects on the skin, so that the produced reaction is not more than inconvenient, and of course making sure that the therapeutic effects of the radiation is not diminished.

"2. The X-ray Tube. If a large amount of current is used the tube becomes too hot and the penetrative radiations are no longer produced, at least, in bulk. Penetrative radiation is wanted, and I have found that with the tube I use, 5 ma. can be 'passed' for ten minutes, the tube remaining in an effective condition, provided that adequate cooling arrangements are made. The method now resolves itself into giving a number of exposures of ten minutes each, spread over a considerable time, in order that the effect on the skin may be watched, that is, if a skin reaction develops before the number of exposures aimed at is reached, then one can stop and know that the skin is quite safe. The number of exposures which have been found to be effective is twelve." (*Vide* also "Churchill's System of Treatment," Vol. III.)

Dr. Robert Knox writes, "The anterior abdominal wall from the level of the umbilicus to the margin of the pubic arch is divided into a number of 'areas' or 'ports of entry' by means of a skin pencil. Each area varies in size according to the number of doses decided upon; generally from four to eight on the anterior wall. Four areas are marked on the posterior surface of the pelvis to include the whole of the sacrum. Through each of these areas an estimated dose of radiations is administered. The first series of doses is given just after the cessation of a period, if that is possible. About ten areas are given to complete each series; these can be given in one day or on two consecutive days. The latter method is preferable in a number of cases. After the first series of doses the condition of the patient is often aggravated. The second series is given as soon as possible after the next period; generally three weeks to a month after the first.

"Some improvement may follow the second treatment in nearly all cases; it is marked in the third. The cessation of menstruation marks the commencement of gradual improvement, with a general improvement in tone. Diminution in the size of the tumour is usually noted. To produce a satisfactory result in the average case takes from three to six months. These results can in special cases be expedited by giving heavier doses. I believe it could be done in one sitting, but on the whole I prefer to use the longer method as it disturbs the patient less and is a more natural process. The results obtained are excellent in most cases."

In my own experience the immediate results of the sittings may be either:—(1) Immediate cessation of menstruation without any return; (2) A profuse loss at the next menstruation and then entire cessation; (3) Gradual diminution in the amount lost, with final cessation; (4) Increase in the hæmorrhage temporarily; (5) No change.

The more remote effects of X rays are not at present clearly defined. For instance, what effect has a course on the action of the uterus, intestines, bladder, and other pelvic organs? There seems to be no doubt that not only does atrophy of the ovaries take place, but that there is some far-reaching effect on the uterine muscle, that probably the blood composition is in some way affected, and lastly that the general health of the patient may be in some way modified, usually by a feeling of improvement in tone. It has recently been found that many patients suffer more or less from nausea, without actual sickness. This has been attributed to the presence of ozone and may be relieved by inhalation of eau-de-Cologne. In three cases I find recorded that the patients suffered from attacks of faintness after the sittings. The menopause takes place quite gradually and without the usual disturbances, such as violent flushings, sweats, palpitation, and the like, which are frequently met with in the normal change of life.

It was thought that the therapeutic value of X rays was due solely to their action on the ovaries, the ova, superficial and deep, being destroyed: although this is probably the chief result, the X rays appear to have some influence on the muscular wall of the uterus itself, as is shown by one of the cases detailed.

The classes of cases in which I have recommended the treatment are as follows:—

(1) Fibroids of the uterus, whether producing hæmorrhage or pain or the subject of rapid growth. (2) Myofibrosis or metritis. (3) Carcinoma of the

cervix, and as routine treatment before, during, and after complete extirpation of the uterus. (4) Colitis. (5) For sterilization after Cæsarean section, in place of exsection of the tubes: also in severe dysmenorrhœa and osteomalakia. (6) Constitutional hæmorrhagic diseases (hæmophilia, purpura hæmorrhagica). (7) To promote absorption in old-standing chronic thickening. (8) Certain skin diseases of the vulva, namely, pruritus, leucoplakia, etc.

As an operator of more than 30 years experience I have had many opportunities of watching the remote results of my own cases and those of others, and I have been struck with the fact that many, although brilliant immediately, have later not fulfilled the expectations of the operator; for instance, a hæmorrhagic fibroid may have been removed, yet although the patient has lost the hæmorrhages she remains a mental and often physical wreck. Again, ovaries and tubes have been removed for various pelvic conditions, and, although the operation has been skilfully and completely done, the patient's condition is either unaltered or may be somewhat worse than before the operation. These facts have necessarily made one ponder as to whether some less drastic treatment might not have been successful in these cases, and there is no doubt that a certain percentage of all pelvic disease may or might have been better and more satisfactorily treated by the exhibition of X rays.

(1) Uterine Fibromata.

The exhibition of X rays in fibroids has generally been limited to those which have produced severe hæmorrhage and sometimes pain, the reason being stated that these are generally cases of interstitial myoma, and that submucous fibroids are better treated by surgical means; moreover, that the subserous forms are not amenable to X-ray treatment. With these opinions I am not quite in accord. I have found that all varieties of fibroid, if properly selected, may be satisfactorily treated by X rays. I therefore propose to mention a few illustrative cases to substantiate my argument, taking for granted that the interstitial fibroid is the usual variety most likely to respond to treatment.

Case 1. Subserous pediculated fibroid, producing severe pain, failure to remove by abdominal operation and by radium, entire relief by X rays.

The patient, aged 41, single, was quite well and strong until five and a half years ago, when she had a good deal of grumbling pain in the right iliac fossa. The abdomen was opened and the appendix and right ovary removed. Nine months later pain began in the left side and back, and it was found that there was a small myoma just above the cervico-corporeal junction posteriorly, the size of a cherry, pediculated, and tender to the touch. The pain came on in severe paroxysms, sometimes after defæcation, sometimes independent of that function. Radium was tried without permanent effect, although she remained free for three months. At the end of that time the pain returned with increasing severity, and required subcutaneous injections of morphia to give her any relief. An attempt was made by reopening the abdomen to remove the growth, but it was found to be intimately attached to the rectum, so the abdomen was therefore closed.

A course of X rays was suggested and tried; from that time she has had no return whatever of the pain, and as this is two years ago it may be fairly looked upon as a cure. She has had bad flushes, with sweats and headaches, which have been easily controlled by small doses of thyroid. Amenorrhœa has existed from the time of the sittings, and six months ago the fibroid could scarcely be felt. She is now in robust health, able to take a large amount of exercise and has no further return of the attacks of pain.

Case 2. Rapidly growing interstitial myoma with subserous nodules, X rays producing great shrinkage.

The patient, who when I first met her was aged 41, in 1908, was sterile, with considerable dysmenorrhœa and obstructive dyspareunia. The uterus was quite normal and dilatation of the cervix and vagina entirely relieved both symptoms. Six years later she began to have menorrhagia, and this continued with increasing severity in spite of all remedies.

I did not see her until early in 1916, when a large bi-lobed swelling, reaching to within two fingers-breadth of the navel, was found. Hysterectomy had been arranged to take place within a few days, owing to her rapid decline in health. I strongly advised a trial of X rays before extreme measures were resorted to, and she had the usual course of sittings. One period occurred during these and one after, amenorrhœa since. Nine months ago examination showed disappearance of the growth from the abdomen and the uterus reduced to the size of a fœtal head. Her general health has in consequence become practically normal, and she is able to play golf and carry out her domestic duties as well as before the illness.

Case 3. Interstitial myoma in patient unsuited for operation: two sets of sittings brought about entire relief of symptoms.

This patient was first seen with the late Dr. Stanley Smith, being the first case in which I recommended treatment by X rays. She was a woman of 50, a multipara who had had for four or five years a large myoma reaching half-way between the navel and the epigastric notch. She was suffering from severe hæmorrhages, with only a few days interval free. Her condition was one of considerable gravity, as her heart muscle appeared to be undergoing degeneration; there was marked œdema of the feet and legs and she was entirely confined to her bed: she was also the subject of emphysema and bronchitis. Operation had been vetoed by more than one physician who had seen her in consultation, and the outlook was not encouraging. She went through one course of X rays with considerable diminution of the hæmorrhages and a general feeling of improvement in health, the œdema becoming much less, but no alteration was noted in the size of the tumour. Three months later she underwent a second course, with the most gratifying results: the hæmorrhages entirely ceased, the œdema disappeared, and the tumour shrank to a level midway between the symphysis and the umbilicus. It has remained of this size since. The patient herself has so far recovered that she is now able to walk three or four miles. She has had no menopausal symptoms of any importance.

Case 4. Combined submucous and subserous myomata in a patient in whom hysterectomy or severe operation was impossible, one course of X rays resulting in extrusion of the submucous growth and its subsequent removal by surgical means. Complete amenorrhœa and shrinking of the subserous growth.

The patient, aged 40, and the mother of several children, had for six months been suffering from rapidly increasing menorrhagia. During some of the attacks her condition became very serious from the effect of the flooding on her heart.

Examination showed a mass the size of a football reaching to the level of the navel. Her general condition was most unfavourable, her mental attitude was unsatisfactory, her pulse small and often reaching 130 per minute. I examined her carefully under an anæsthetic, with a view to making out the exact nature of the growth. It was found that the mass consisted of two tumours: one a submucous fibroid with no pedicle, the size of a fœtal head, and a slightly larger subserous sessile growth, lying on the posterior wall of the uterus, the two growths fitting each other and producing to the touch the sensation of one tumour. Her condition was such that a prolonged operation on the submucous fibroid was quite out of the question, especially as the cervix was long and tightly closed. As her next period was due in eighteen days, all the necessary preparations were made to combat the hæmorrhage which was thought to be inevitable. In the meantime I strongly advised as many sittings of X rays as possible.

The subsequent course of events was somewhat remarkable. The period came on at its proper time and was absolutely normal; amenorrhœa has existed since. Examination immediately after the period showed that the cervix was three quarters dilated and that a large mass was presenting. The X rays were continued, and fourteen days later the growth was in the vagina, with a pedicle as thick as the wrist. I felt that this could be removed without great risk, and with a specially strong écraseur I cut the pedicle through and delivered the growth with modified midwifery forceps. On passing the hand into the uterus the subserous growth could be distinctly felt outside the uterine wall. Some slight evening temperature had occurred previous to operation for some few days, owing to absorption from the surface of the submucous growth, but her progress after was uneventful. There has been no return of menstruation, the remaining fibroid is shrinking, and her general health is rapidly improving. Menopausal symptoms are slight and have required no treatment. The action of the rays on the expulsive power of the uterus seems to be fairly established by the progress of this case.

Another case showing the value of X rays may also be mentioned. The patient, a middle-aged woman, and suffering from a large myoma producing hæmorrhage, had undergone the operation of oöphorectomy, with the object of arresting menstruation. Unfortunately, the bleeding went on as before, and I recommended a course of X rays. These sittings were followed by an extremely good result, as the patient ceased menstruating and has remained well for two years.

I have selected the above as illustrative of every variety of fibroid; each one benefited, I will not say permanently, by the action of the X rays. They cannot, however, be called conclusive, as they are so few in number and sufficient time has not yet elapsed to call them permanent cures. They have made, however, a great impression on my mind, and I certainly think that every case of fibroid tumour, either causing symptoms from rapid growth or hæmorrhage, should undergo a preliminary course of X rays before definitely deciding on hysterectomy.

I have met with nineteen cases of interstitial growths which, with three exceptions, have been so far almost entirely relieved of their symptoms by the X rays; cessation of the hæmorrhages and shrinking of the tumour being well marked; I cannot yet give a reason for the failures. In one of them a very severe burn, followed by sloughing of the skin, took place, and six weeks elapsed after a plastic surgical operation before even deep union took place. In one of the successful cases, the nerve shock of an air-raid brought back a sharp hæmorrhage after six months amenorrhœa, but the shrinking of the tumour has steadily gone on.

As a rule, the best cases of fibroid to respond to this treatment are those occurring at the age of 40 or thereabouts, slow-growing, interstitial in position and producing either hæmorrhage, pain, or pressure symptoms, but I have recorded in my notes three cases occurring in comparatively young women, namely, aged 27, 29, and 32, where the tumour was first noticed owing to its rapid growth. There was in addition a slight excess of menstruation, but it could not be called flooding. In these three cases, after duly warning the patient of the possible outcome of the X rays, namely, sterilization, the result was most satisfactory, as amenorrhœa occurred in all three, the tumour gradually shrank, leaving only an intra-pelvic lump.

The class of fibroids which are obviously not suitable for this treatment are submucous pediculated fibroids and those affected with the various degenerations, namely, myxomatous, cystic, calcareous, necrobiosis or red degenerations, and infiltration from the endometrium of malignant disease. I might add that it is almost impossible to diagnose some of these degenerations, and the failures I met with are quite possibly due to the presence of one or other of these conditions.

(2) Myofibrosis or Metritis.

These cases are distinguished by a general and equal enlargement of the uterus, due to uniform thickening of the walls. *The* symptom is practically more or less severe menorrhagia. It usually occurs after childbirth or a miscarriage, but may arise apart from either of these conditions. The important point is that curettage, which is usually carried out, makes the hæmorrhage worse, as anyone who has met with a case is well aware; it is very rare to find any marked disease of the endometrium when it is removed by the curette. Now this condition is particularly amenable to X-ray treatment, and I have seen five cases in which one set of sittings produced an entire cessation of menstruation and a gradual atrophy of the uterus. It is obvious that before applying the treatment it would be safer in all such cases to explore the uterine cavity; in this way primary malignant disease of the body will be eliminated. This treatment was adopted in all five cases that I have mentioned.

(3) Uterine Cancer.

The value of X rays in cancer of the uterus is at present uncertain: there seems to be no doubt, however, that the action of the rays is to limit or circumscribe the growth, and some cases have been reported in which the disease has been apparently cured, at any rate for some length of time. It has been suggested, therefore, that all cases of cancer, especially of the cervix, should be subjected to X rays before, during, and after operation, if possible. I have had experience of only two cases in which this treatment was partially carried out; they were both cases of cervical cancer in which I performed total hysterectomy, and immediately afterwards they were subjected to a course of X rays. The first operation was performed three years and the second two years ago, and both so far have remained free from recurrence of the disease. It would be unwise to attribute this immunity to the X rays, but I think this course of treatment would be a good one to carry out in all such cases.

(4) Colitis.

In treating cases of colitis with the X rays, the disease itself is not the object of attack. I have frequently noticed in any bad cases of colitis that for 7-10 days before and during menstruation the disease is very much aggravated, and that during pregnancy, when ovarian activity ceases, the condition often becomes very much improved. Acting on this knowledge, it suggested itself to me that in very bad cases sterilization of the patient might be beneficial, and I have recently had two instances of this treatment. One was a case of hæmorrhagic colitis, with rapid emaciation and more or less constant diarrhœa. Every treatment at present known, both dietetic and otherwise, had been tried without avail. The only time of comparative freedom she had from the illness was during the week following the cessation of a period; the week preceding a period and during the actual flow the disease was always much aggravated. As she was 36 years of age, and had had five children, it was felt that here was a case which might be benefited by sterilization. She was therefore subjected to a course of X rays. This was carried out two years ago and the result has been very satisfactory, menstruation has ceased and the colitis has almost disappeared, but she still gets a slight return of the symptoms at the time the period would otherwise have appeared.

The second case was one of ordinary colitis and has followed much the same course. Although, however, amenorrhœa has resulted and the colitis is much improved, sufficient time has not yet elapsed to call it a cure.

I think these two cases are well worthy of consideration. Allowing for the element of chance, they rather point to a hopeful termination in some of those intractable cases of colitis which occur so frequently in women. At the same time it must be distinctly stated that I do not recommend this treatment as routine practice in colitis.

(5) For the Artificial Production of Amenorrhœa

This includes treatment by X rays of cases such as severe dysmenorrhœa caused by non-development of the uterus. Those who have seen cases of this nature will bear in mind the great suffering such patients frequently endure: each menstrual period, from its first appearance, is like a miniature labour, often lasting two or three days. Dilatation of the cervix produces no relief of the symptoms and resort is necessary to drowning the pain by means of drugs. This method inevitably means increased doses of narcotics and lowering of the moral fibre of the patient. Hitherto, the only drastic treatment which has been recommended has been complete hysterectomy, but I think that sterilization by means of X rays is a much more efficient method. I have had one such case where the uterus, including the cervix, was only 1½ inches long. A course of X rays produced complete amenorrhœa, and for the last eighteen months the patient has been in rapidly improving health.

In another case of similar nature which I have just seen, and where the uterine cavity was slightly over an inch, the symptoms were even more severe. This patient is now going through a course of the same treatment, but I am unable so far to give the result.

The second class of case under this category is sterilization of the patient as a part of the operation of Cæsarean section. As is well known, it is usual for the patient to be asked to decide whether she will be sterilized at the time of the operation, and, if she wishes it, exsection of a portion of each tube is carried out. I felt that sterilization by X rays would be equally advantageous if successful, and in one case of this operation for pelvic contraction an excellent result has been produced, and I propose in any future case of Cæsarean section which comes under my notice to suggest this treatment to the patient.

(6)

There are other conditions which may be discussed with regard to the use of X-rays, namely, some of the hæmorrhagic diseases, such as hæmophilia and purpura hæmorrhagica, in which very often menstruation is alarmingly excessive, sometimes requiring plugging of the vagina. I have one case of the former disease now going through a course of X-ray treatment, but am unable to give the result of the treatment at present.

It has been suggested that X rays may promote absorption of old standing chronic thickening in the pelvis, but of this I have had no experience, although I think it is quite likely that the results might be favourable.

And lastly, certain diseases of the vulva, such as leucoplakia and pruritus, are certainly benefited by the use of X rays.

Having so far enumerated the classes of cases which have come under my notice and which I think may be benefited by this therapeutic measure, I will next consider what are the advantages and disadvantages accruing from its adoption, as compared with operation.

1. *Advantages.* (*a*) The treatment is quite painless. (*b*) It occupies one to three months only, and if it fails operation can be carried out under the same conditions as before the sittings. (*c*) In a successful case the menopause which results is not usually attended by any of the nervous

disturbances noticed in many cases of normal or post-operative menopause. (*d*) The cost is infinitely less than that entailed by operation. (*e*) Sittings may be given during menstruation without detriment, although some observers assert the contrary. (*f*) Lastly, the bad after-effects so frequently noticeable in operative cases are not observed.

2. *Disadvantages.* (*a*) The length of time which must necessarily elapse after the sittings have taken place before a permanent cure can be ascertained to have resulted. For instance, in some fibroids rapid shrivelling, in addition to cessation of the hæmorrhage, takes place; in others, the cure is not so rapid and may require a second series of sittings, and even then the fibroid only partially disappears. Moreover, we are not yet certain that at some more or less remote period after the sittings there may not be a recurrence of the symptoms, although this is not common. (*b*) The danger of burning of the skin: this is practically a preventable accident, and I have no doubt that as improvements go on this will never occur. As already related, it happened in one of my earlier cases of fibroid tumour and caused an immense amount of distress and trouble. (*c*) The possibility of some malignant change taking place in the atrophied uterus or fibroid tumour.

In concluding these few remarks I can only say I have endeavoured to give my own personal experience, and as this is comparatively small and extends over only seven years, it would be unwise to dogmatise on results. I have, therefore, placed my facts before you for careful consideration, without wishing to influence you for or against the treatment. I may say, however, that my own personal feeling is that in X rays we have a very powerful remedy, which with increasing accuracy of diagnosis and administration promises to be of inestimable value in the pathological female economy.

PHARYNGEAL POUCHES.*

By N. S. Finzi, M.B., Captain R.A.M.C.

Pharyngeal pouches, sometimes erroneously called œsophageal pouches, are diverticula or herniæ of the posterior and postero-lateral wall of the pharynx, behind the cricoid, into the loose areolar tissues behind the pharynx and œsophagus. Fig. 1 shows how the oblique and fundiform parts of the crico-pharyngeal muscle (inferior constrictor), which normally are quite close together, are in these cases separated, possibly congenitally, thus leaving the pharynx with no supporting muscular wall. A diverticulum forms which will tend to become larger and larger, its contents exerting an ever greater pressure as they increase in amount. A general dilatation of the pharynx is also known. Fig. 2 shows the diverticulum in the early stage and Fig. 3 in a later stage. These three slides are drawings from specimens at the museum of the Royal College of Surgeons, and they were kindly lent me by Dr. William Hill.

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* Figures 1 to 12 of this article are reproduced, with permission, from the "Proceedings of the Royal Society of Medicine," Vol. X, No. 4.

I am concerned this evening only with the *radiographic* examination, appearances and diagnosis of these cases.

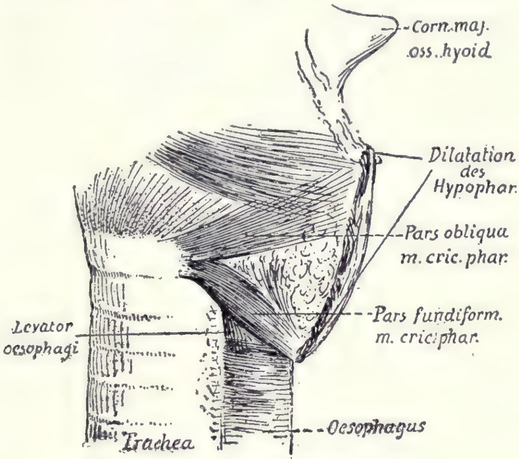

FIG. I.
Dissection of the muscles of the pharynx (diagrammatic).

The method used is the administration of a thick paste of bismuth oxychloride and water of such a consistency that, when heaped up, it has practically no tendency to flow back to its level. A bismuth meal, bismuth and sugar, or barium sulphate and water are not so good, the first because it is not sufficiently opaque, and all of them because they do not stick to the œsophagus and outline it after the main mass of them has passed. The bismuth paste, however, has the property of giving quite a good outline of

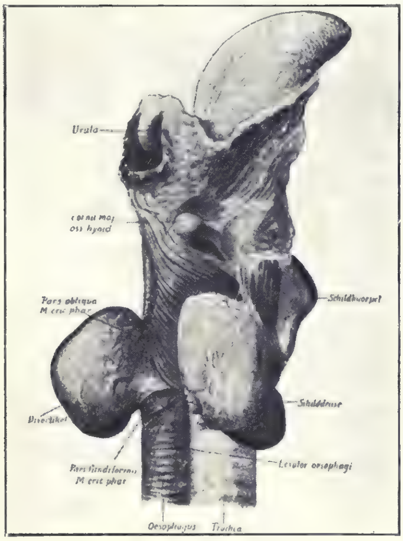

FIG. 2.
Pharyngeal diverticulum commencing to form.

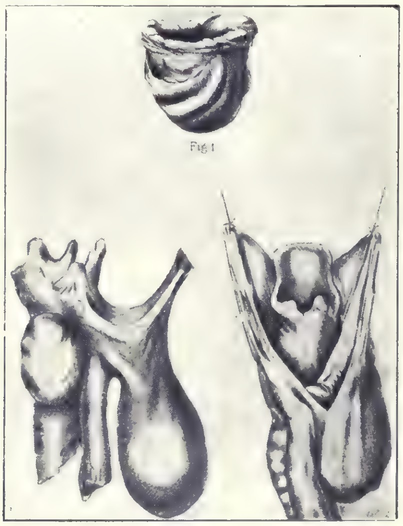

FIG. 3.
Pharyngeal diverticulum in a later stage.

the œsophagus for a variable time after a bolus of it has been swallowed. The fluorescent screen examination of these cases is most important, as they may be very difficult to distinguish from stricture unless it is seen how the bismuth leaves the pouch. A pouch can be observed to fill and, when full, the bismuth passes into the œsophagus, going past the upper end of the pouch with ease, but being held up lower down in those cases in which the pouch is big enough to press on the œsophagus (Fig. 10); in some cases the pouch can be observed to empty into the œsophagus when the patient contracts the neck muscles. On the other hand, in stricture, the bismuth passes, if the stricture is not complete, from the lower end of the dilated portion of the gullet.

A plate examination always follows the screen examination and, if an intensifying screen is used, an instantaneous exposure may be given, but this is not so important as it is in the lower part of the œsophagus, for if the patient refrains from breathing or swallowing there is no movement of this part of the gullet such as that caused by the heart and aorta in the lower part.

I find that when the pouch does not extend into the thorax a true lateral view gives a far better picture than the oblique antero-lateral view, though the latter is always useful. The plate may be placed close to the neck, with a cushion to keep it in place, but though this gives the clearest definition the lower end of a large pouch may be missed; but in some cases the whole pouch with the adjacent structures may be raised, and kept raised for a few seconds, by a tractable patient, if he will keep them in the position they reach at the commencement of the act of swallowing. In many cases, and always when an intensifying screen in a casette is used, the plate will have to be placed some distance from the neck owing to the shoulder getting in the way; so that it is essential to have the X-ray tube a long way off in order to get parallel rays and avoid distortion. A posterior or an anterior view must also be taken, the former usually giving the clearer picture. I always examine the patients standing up.

I now show you a picture of the pharynx and upper part of the œsophagus, not quite normal it is true, for there was a polypus causing a slight partial obstruction, but it gives a general idea of the appearances in a normal case. Fig. 4 shows the appearance in the same position, right antero-lateral oblique, of a pharyngeal pouch, and Fig. 5 of a typical carcinoma.

In the pouch a dark shadow is seen with a rounded lower border, and the bismuth which has already passed down the œsophagus has outlined it, showing that it is obviously unconnected with the lower end of the pouch shadow. In the carcinoma case the lower end of the shadow of the dilated part of the œsophagus is conical, with irregular projections into the gullet below the cone, these latter being fungations of the growth. The bismuth is obviously leaving the dilated part at its lower end.

Differential Diagnosis.—What a pouch generally has to be distinguished from is a malignant stricture, but a fibrous stricture may also simulate a pouch; I do not believe a spasmodic stricture will do so, as it is unlikely to

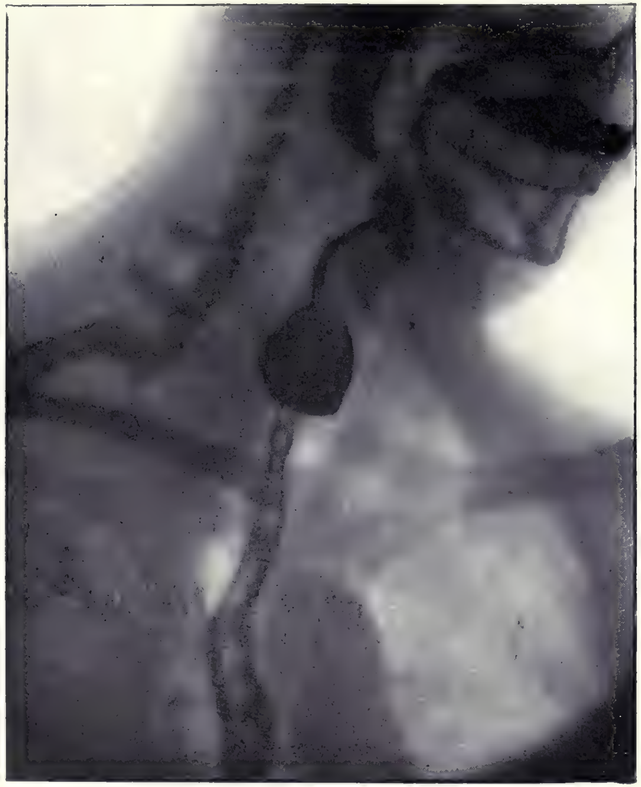

FIG. 4.

Pharyngeal pouch : right antero-lateral oblique view.

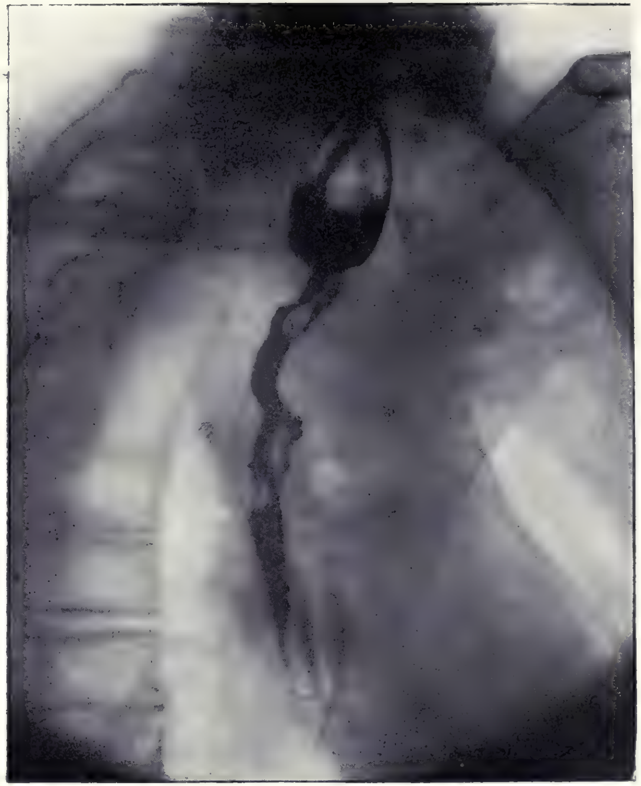

FIG. 5.

Carcinoma of œsophagus : right antero-lateral oblique view.

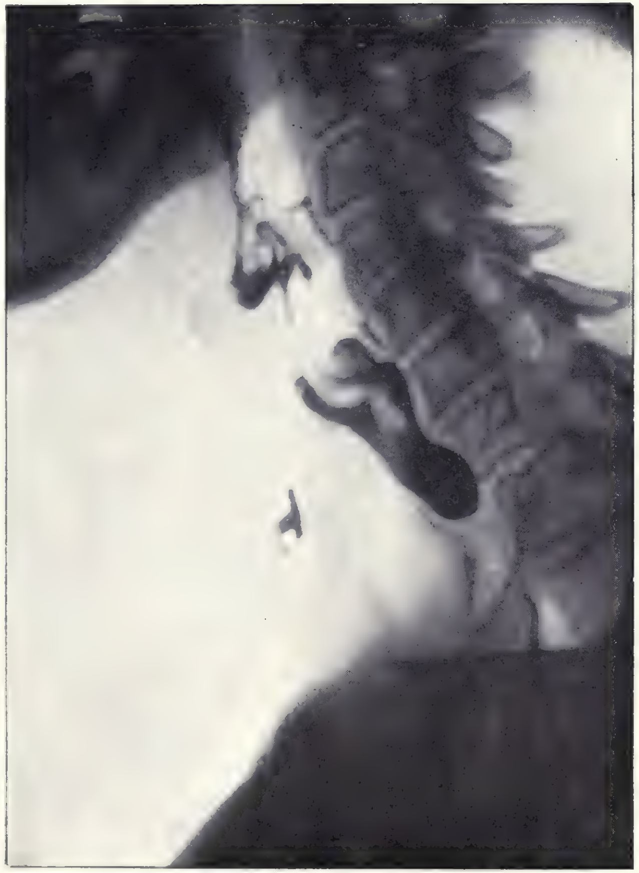

Fig. 6.

Typical pharyngeal pouch of medium size : left lateral view.

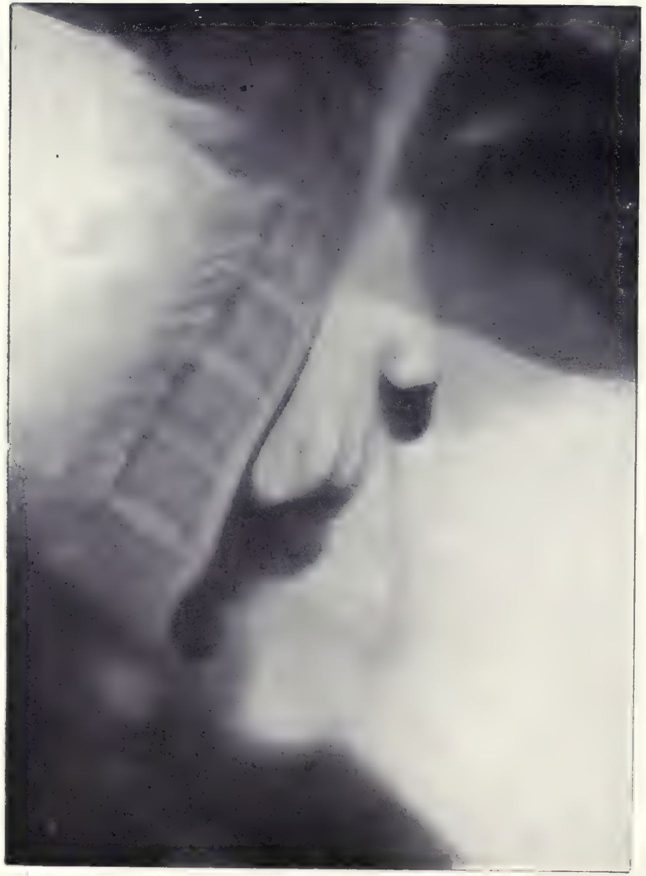

Fig. 7.

Carcinoma simulating a pouch : right lateral view.

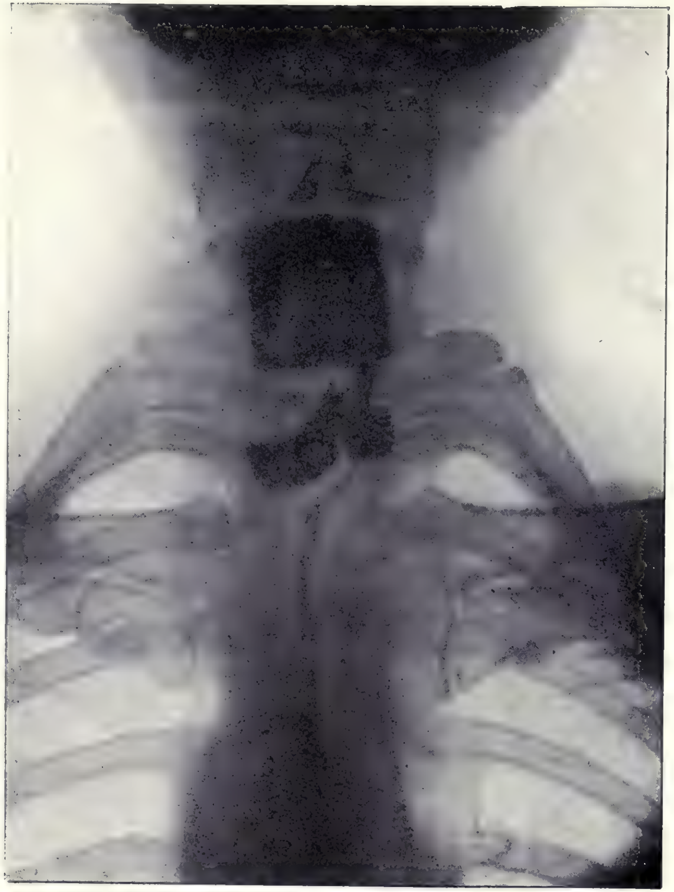

Fig. 8.
Pharyngeal pouch: posterior view.

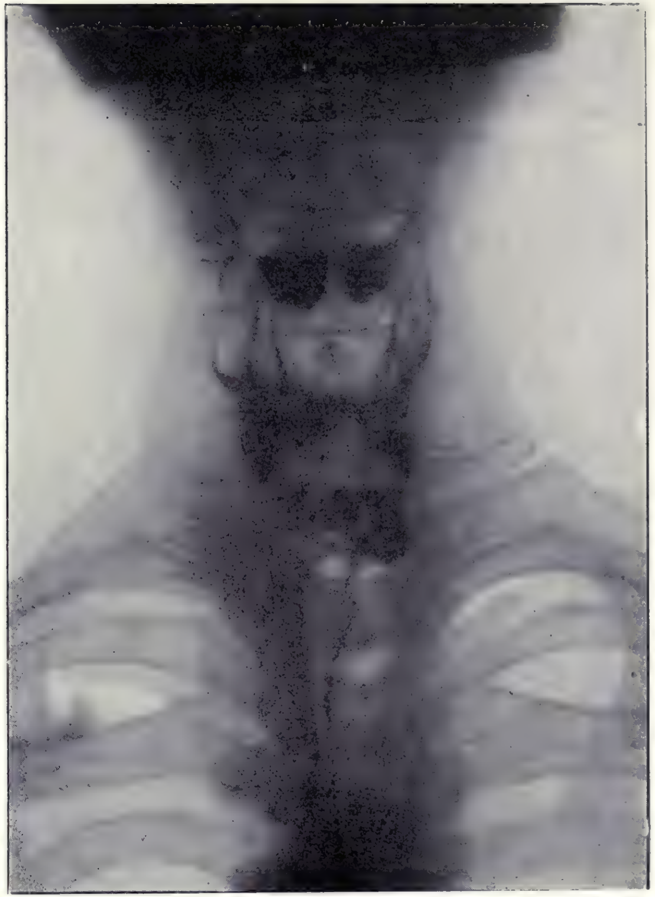

Fig. 9.
Carcinoma of œsophagus, simulating pharyngeal pouch: posterior view.

occur in this position. *The cardinal difference between a pouch and any form of stricture, however, is the fact that the former must empty from its upper and the latter from its lower end*, and this can generally be made out by a careful screen examination on the lines I have indicated. A carcinomatous stricture is usually conical in shape and has not the bulbous appearance seen in the case of a pouch. In the radiogram a carcinoma may, however, simulate a pouch, as shown by Figs. 7 and 9. There are two points in the lateral view in which this case differs from the pouch. In the first place a little point of bismuth is seen projecting from the lower end, whereas in the diverticulum case, Fig. 6, the bismuth is obviously passing down in front of the pouch; in the second place there is a "waist" to the bismuth shadow in the carcinoma case, about 1 in. above its lower end; neither of these by itself is absolute proof, though the former is most suggestive. In the posterior view (Fig. 9) the real nature of the case betrays itself, for it is now

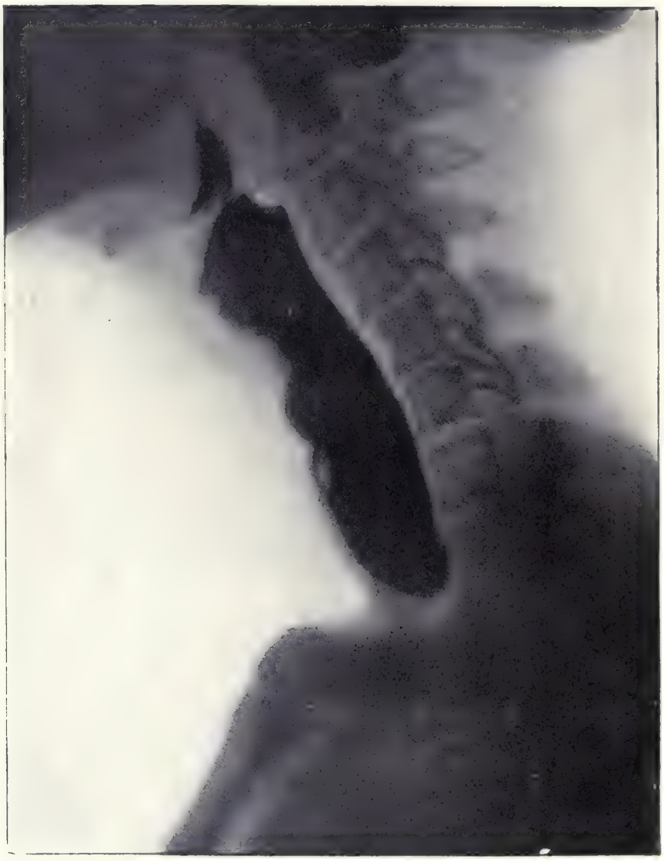

FIG. 10.

Large pharyngeal pouch: left lateral view. The lower end of the pouch is pressing on and obstructing the œsophagus. The thin streak in front of the main shadow is the bismuth passing into the œsophagus.

seen that, on one side, the end of the shadow is irregular and does not extend so far down as on the other, while evidence is present of fungations both in the main shadow and below it. More important is the fact that the pouch emptied from above, whereas what got through the carcinoma came out below. In the skiagrams of the pouch the lower end may be hitched up in the middle (Fig. 8), but it is quite smooth and rounded and there is no trace of fungations. The correctness of the diagnosis in both these cases was subsequently proved.

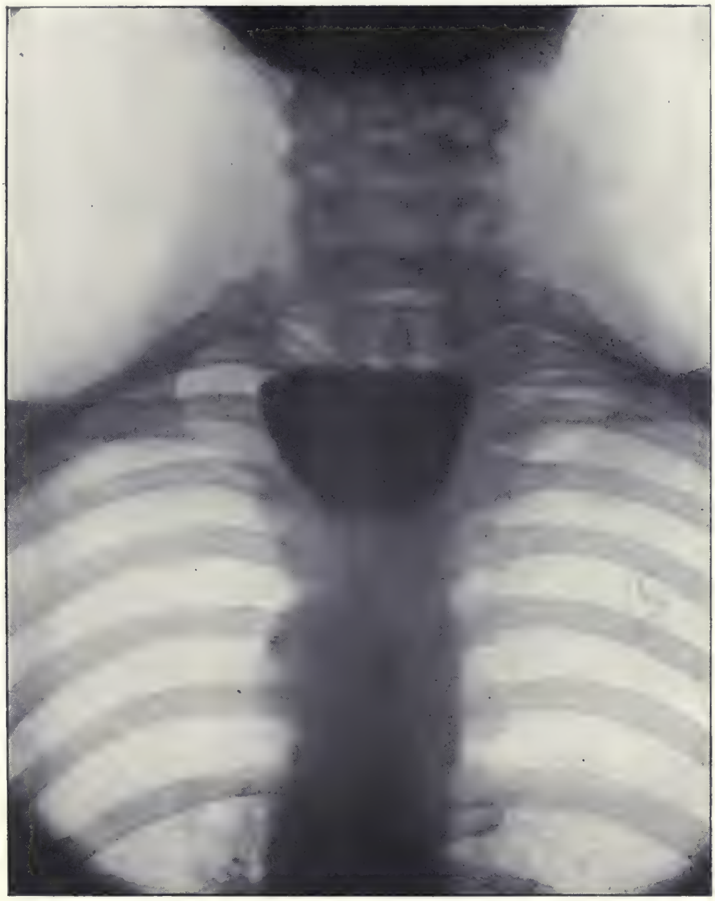

FIG. 11.

Large pharyngeal pouch : posterior view.

A fibrous stricture may be even more difficult to distinguish, though it is fortunately rare in this situation. Here one is not helped by the presence of fungations, though the stricture is likely to give a conical lower end to the bismuth shadow. A screen examination will, however, distinguish.

If the pouch were so large as completely to obstruct the œsophagus, either directly or as the result of inflammation or adhesions, the diagnosis might be extremely difficult. Whether such a case can occur I do not know. One of my cases (Fig. 10) was very near it, and he had in fact had a gastrostomy for three years before his pouch was diagnosed and removed. In the lateral view of this case the bismuth is seen to be filling not only the pouch but also the pharynx, and is seen to be escaping into the œsophagus, in front of the pouch. There is considerable obstruction of the œsophagus by the pouch, and this had in fact led to a diagnosis of malignant disease at a previous X-ray examination.

Fig. 11 shows the posterior view of a very large pouch, and Fig. 12 the right antero-lateral oblique view of a very small one.

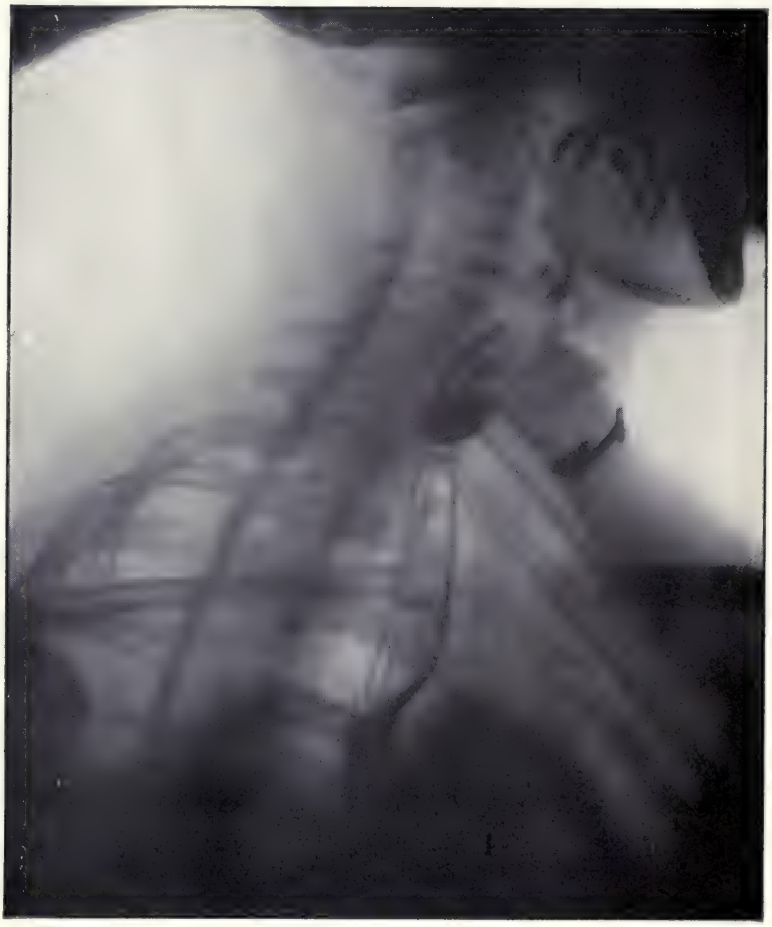

Fig. 12.

Small pharyngeal pouch: right antero-lateral oblique view.

Figs. 13 and 14 are two views of an early case, and Figs. 15 and 16 two views of a late one.

These cases are supposed to be very rare, but all these eight cases have occurred in my private practice during four and a half years, and I have also examined hospital cases during the same period. Their correct diagnosis is of the utmost importance owing to the radical difference between their treatment and that of the conditions which they simulate. I, therefore, trust that this paper may be of some use in pointing out some of their characteristics.

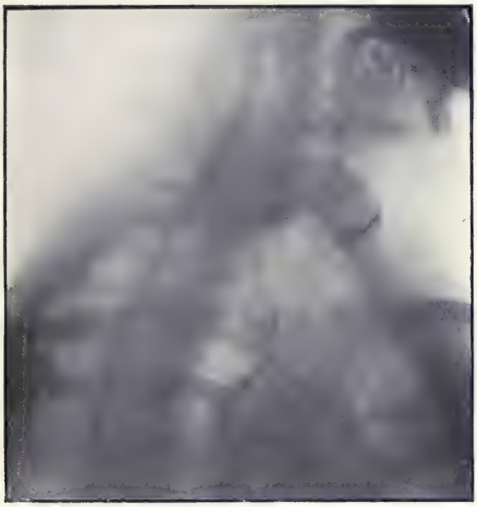

FIG. 13.

Right antero-lateral oblique view of an early pharyngeal pouch.

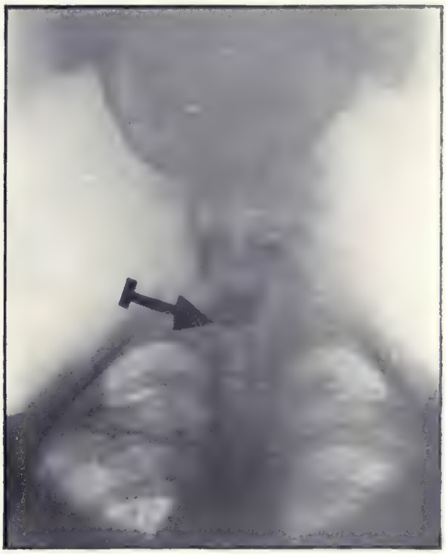

FIG. 14.

Posterior view of the same case.

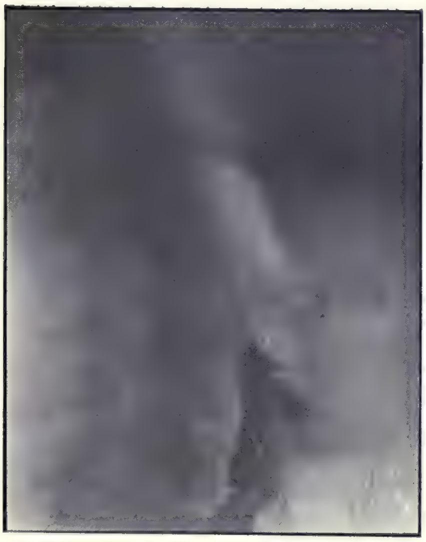

FIG. 15.

Lateral view of a large pharyngeal pouch, with the plate close up against the neck, showing how the lower end of the pouch is missed.

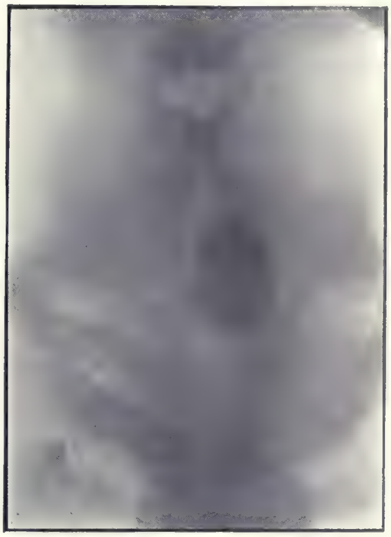

FIG. 16.

Anterior view of the same case.

THE INTENSIFYING SCREEN: ITS PROPERTIES AND USES.

By T. Thorne Baker, F.C.S.

It is generally known that an intensifier screen is coated with the crystalline form of calcium tungstate, $CaWO_4$, which occurs in Nature as the mineral scheelite, or can be produced from amorphous tungstate of lime by raising it to a very high temperature in the presence of a gas which has the necessary catalytic effect. Calcium tungstate is readily prepared by decomposing a soluble calcium salt with the ortho- or para-tungstate of soda, but the spectrum of the fluorescence produced varies slightly, according to the molecular composition.

Intensifier screens are very generally employed at the present time to reduce the length of photographic exposures, especially when dealing with the thicker parts of the body. A great deal more can be done with them than is generally supposed, and many of the alleged drawbacks disappear if the screens are used in a manner compatible with their physical qualities.

Various substances fluoresce under the influence of the X rays, notably, of course, barium platinocyanide; willemite, or zinc silicate, zinc sulphide, uranium potassium sulphate, and calcium molybdate, are other substances possessing this property; but, with the exception of calcium molybdate, the spectrum of the fluorescent light produced is unsuitable, as clearly the spectrum must be as nearly as possible the same as the region of the spectrum to which the photographic plate possesses maximum sensitiveness.

Reference has been made recently[1] to the possibilities of producing an intensifier screen which better complements, from a spectroscopic standpoint, the maximum sensitiveness of photographic plates, and the experiments of Elizabeth MacDougall, Stewart and Wright,[2] with zinc sulphide, suggest confirmation of the possibility. Zinc sulphide, prepared at a temperature of 650° gives blue phosphorescence when excited by radium rays (and presumably X rays), while higher temperatures give green, and even yellow phosphorescence. Below 650° C. and above 1100° C., the results are very poor. Somewhat similar conditions regulate the preparation of calcium tungstate, the spectrum, up to a point, shifting towards lower refrangibility as the temperature to which it is subjected is raised.

Barium platinocyanide, subjected to the β and γ rays of radium, attains a certain luminosity which diminishes rapidly to about one-twelfth its initial value,[3] and in many other cases the initial fluorescence diminishes; under the action of the X rays the brilliance of calcium tungstate crystals seems remarkably constant, even after several minutes exposure to a Coolidge tube working at 5 milliamperes and a 16-inch spark gap.

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[1] Thorne Baker, *Journal Röntgen Society*, No. 52, 1917.

[2] *Journal of the Chemical Society*, August, 1917.

[3] Beilby, *Proc. Royal Soc.*, A. 74, 1905.

Zinc sulphide, willemite, and barium platinocyanide were shown by Marsden[4] to exhibit decay of luminosity when acted on by radium emanation, and at that time Prof. Rutherford suggested that the luminescent substance contained a number of active centres, with which the α-particles collided in producing luminosity, each such collision destroying an active centre, hence the gradual decay of luminescence (after the maximum had been reached). More recently it has been suggested by Walsh[5] that the active centres, after collision, recover according to an exponential law, so that the rate of decay is somewhat ameliorated.

In investigating the life history of an intensifier screen we have much the same questions to consider, *i.e.*, whether the X rays, in exciting fluorescence in the calcium tungstate, gradually destroy its luminescing properties, and to what extent, if so, they recover. I recently prepared an exceedingly brilliant sample of calcium tungstate by heating the amorphous compound to 1100° C. in an atmosphere of nitrogen ; the sample was almost inactive after a few days, as shown by tests made with an intensifier screen prepared with it. Screens made in the usual way have, on the other hand, shown no marked signs of decay after ten years use with moderately hard X rays.

In other words, the modern intensifying screen is extremely stable, and the chief discrepancy that may appear to those who have not studied the matter is that the reduction in exposure is not so great when dealing with thick parts of the body as it is for very short exposures. It is not so readily excited by the harder rays, just as the ordinary X-ray plate is not so sensitive to hard rays as to soft. In order that any form of intensifying screen should function best, it is essential that a maximum amount of the rays falling upon the screen should be absorbed, as by their absorption their energy is transformed into wave motion of greater wave-length, *i.e.*, photo-actinic rays. I have shown[6] that at least one-third of a beam of moderately soft X rays passes through an intensifier screen ; with many screens even more probably goes through unabsorbed. Further recent experiments have also shown that whereas an intensifier screen coated with a layer of tungstate a millimetres in thickness gives the maximum reduction in exposure with a soft tube, a thickness of $2a$ mm. gives greater reduction when the tube is worked harder, while as much as $3a$ mm. is the best for an intensely hard tube ; in other words, a screen to be used for radiography of the hand or wrist may preferably be coated with as little as one-third of the crystalline material desirable for rapid exposures through the thick parts of the body.

The tendency in all modern X-ray work is to employ beams of greater penetration, and the intensifier screen is going through a sort of transformation stage in consequence.

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[4] *Proc. Royal Soc.*, A., vol. 83, 1910.

[5] *Proc. Royal Soc.*, A., vol. 93, 1917.

[6] *Journal of Röntgen Soc.*, Sept., 1917.

To turn now to more practical matters, attention should perhaps first be drawn to the question of pressure of the screen against the plate. There are various types of screen and plate holders, or cassettes, in use, and most of them are fitted with springs in the back, which press the plate against the screen. If the front of the cassette is not perfectly flat, such as is the case when a cardboard or very thin aluminium front is used, which frequently buckles outwards, there will be uneven contact between plate and screen, and this will cause diffusion of the image, *i.e.*, lack of definition, and great lessening of "speed"; it is quite easy to make an intensifier screen vary as much as 100 per cent. in its reduction of exposure by varying the degree of pressure between its sensitive coating and the film of the plate. The greater the pressure can be made the shorter will be the exposure and the finer the definition. The crystals composing the active surface of the screen become phosphorescent under the influence of the rays, and each one acts as a small light source, so that if the plate is not in firm contact, but separated by however minute a distance, a spreading action from each fluorescent crystal takes place.

This question of good contact and strong pressure is one of such great importance that it cannot be too much enlarged upon; only a series of carefully conducted tests will show the influence of and benefit from pressure; those who complain of lack of detail in screen negatives would do well to examine the effects of pressure.

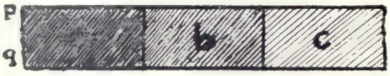

FIG. 1.

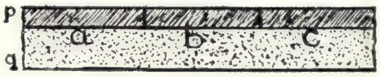

FIG. 2.

Contrast, or gradation, is another matter worthy of consideration. It is sometimes stated that negatives taken with an intensifier screen lack contrast, but the development of a plate exposed through a screen is not the same as that of a plate merely exposed to the rays; and the difference requires to be known and allowed for in order to obtain the best results. Fig. 1 represents diagrammatically the effect of an X-ray exposure of three degrees on the film of a plate without screen; *a* represents the full exposure, *b* less exposure, say, through the flesh of the arm, *c* least exposure, say, through the bone. But in each case the rays have penetrated the entire film *p q*, and, on development, the silver bromide becomes reduced simultaneously throughout the film. Fig. 2 represents the effect of an intensifier screen exposure, where the plate is exposed by the violet rays of the screen, merely on the surface. During development, the image has got to be built up from the surface downwards, which takes longer; the image should always come well through to the back of the plate before stopping development.

Two means are available to get whatever amount of contrast is desired; one is to give the longer development necessary as just shown, following on *correct* exposure, the other is to employ a developer containing more reducer (metol, sutol, hydroquinone, etc.), less accelerator (alkali), and more restrainer (bromide) than one would use for ordinary work without the screen.

The amount of contrast obtainable in a negative is under very considerable control, and modification of the developer will give quite satisfactory results. It may be taken as a general rule that an exposure made with a screen will require at least half as long development again as a plate exposed without one, the exposures in each case being correct. If the amount of reducer be increased by ten per cent., or the alkali reduced by that amount, the development should be nearly twice as long. This point should be borne in mind when testing a screen for the reduction it effects in exposure. If these matters are given due attention, it will be found that negatives obtained with an intensifier screen are not granular, and possess ample contrast and brilliance.

NEW TECHNIQUE.

THE PRACTICAL APPLICATIONS OF THERMIONIC EMISSION.

In a recent review which appeared in this Journal the theoretical aspects of the emission of electricity from hot bodies, as dealt with by Prof. Richardson in his monograph on the subject, were considered. The practical applications have been largely advanced by work carried out at the Research Laboratory of the General Electric Company at Schenectady, and a brief mention of three papers from recent numbers of the *General Electric Review* may not be without value.

The first, by Dr. Saul Dushman, entitled "A New Device for Rectifying High Tension Alternating Currents," gives an account of the development and applications of the instrument known as the "kenotron." The three main points to be treated in the design of the kenotron are, (1) the amount of the current to be rectified, (2) the maximum permissible voltage loss in the rectifier, and (3) the proper shape of the electrodes to prevent electrostatic strains on the filament. With regard to (1), the current carrying capacity is limited only by the area of the surface emitting electrons (that is, by the dimensions of the filament) and its temperature. The maximum temperature at which the filament may be run is determined by its "life." Langmuir's work on the rate of evaporation of tungsten filaments enables the maximum "safe" temperature corresponding to any sized filament to be calculated, and hence, from curves of variation of electron emission with temperature the dimensions for a suitable filament may be chosen. (2) The voltage loss in the kenotron is dependent upon the "space-charge." This effect is due to the production of an electrostatic field by the electrons themselves emitted from the hot cathode, and this field tends to stop the motion of the electrons towards the anode. Equations are deduced giving the energy loss in the tube. This energy is largely absorbed by the anode and heats it, and it is further shown that care must be taken to prevent the full voltage of the circuit coming on to the kenotron by the short-circuiting of the load. In such a case the heat developed at the anode may be sufficient to destroy the tube. (3) With regard to the disposition of the component parts three distinct types of kenotron are dealt with in the paper and their merits are discussed. The molybdenum cap type, somewhat similar in appearance to the well known construction of the Coolidge tube, is satisfactory for small currents (up to 100 milliamperes) and for low voltages (up to 15,000 volts), while for larger outputs, up to 500 milliamperes and 100,000 volts, the cylindrical anode type is to be preferred. In this the filament is placed axially with respect to a cylindrical anode. Diagrams are also given showing suitable connections for the use of kenotrons for the production of high voltage direct currents for laboratory work or for X-ray tubes.

The second paper referred to is by Dr. I. Langmuir, and is entitled " The Pure Electron Discharge and its Applications in Radio-Telegraphy and Telephony." A brief account is given of the theoretical side of thermionic emission and then reference is made to the application of the phenomena to the construction of " valves " for wireless communication The characteristics of the kenotron described above are the incandescent filament and the adjacent anode. These are again found in the "pliotron," but in addition a third electrode is provided; this is the "grid" placed between the hot filament and the anode; it serves the following purpose. In the simple case in which the grid is absent the current between the anode and filament becomes limited by the space-charge mentioned above, which prevents many of the electrons emitted from the filament passing across to the anode, they merely return to the filament and are there absorbed. If now a positive charge is maintained between the anode and filament the negative electrostatic field is weakened and a much larger number of electrons cross the space. The grid, consisting of a close spiral of wire connected to a suitable potential, is employed for this purpose. In this way the application of a small positive potential to the grid releases a larger negative current from the filament to the anode, and the device thus acts as an amplifier in addition to its rectifying properties.

The third practical application of thermionic emission is the Coolidge tube, and this is now so well known to X-ray workers as to require no description here. The stray radiation from the tube has, however, been investigated recently by Dr. W. D. Coolidge and C. N. Moore, and they deal with this matter in the issue of the *General Electric Review* for April, 1917. The method employed in the experimental work was to photograph the tube by means of its own radiation through a pin-hole in a lead box. The tube was always placed with its focal spot at a distance of fifteen inches in front of the pin-hole, while the photographic plate was situated five inches behind. In practically all the tests the standard exposure was ten minutes with a current of four milliamperes at an equivalent spark-gap of seven inches. As a result it is seen that radiation is given off from the whole of the anticathode and supporting rod in the case of an ordinary Coolidge tube. Various devices were then tried in order to minimise the effect and the results are shown in the paper by means of a series of photographs. The devices comprise, (1) the provision of a hood over the anticathode, (2) the use of a copper support for a tungsten button employed as the target, (3) the placing of the anticathode support at right angles to the length axis of the tube, (4) the provision of an insulated diaphragm in the tube in the path of the emergent rays. The last mentioned device was found to be quite effective, and further, gave the least limitations in the ordinary use of the tube. Test exposures were then made comparing this special tube with the standard type under normal conditions of working; the resulting radiographs were practically identical, and it is concluded that the small part played by the stray radiation is not sufficient to warrant the special methods being employed to minimise it, in view of the other limitations thereby introduced.

W. F. H.

RADIOGRAPHY OF METALS.

By W. P. Davey,

General Electric Review, Vol. XVIII., pp. 795-800, 1915.

The examination of metals by X rays to detect flaws, etc, is a matter of considerable importance at the present time, and in this connection readers of the Archives of Radiology may be interested in the data published in the above mentioned paper. The metal employed throughout the tests was steel, and the exposures were made on Seed X-ray plates, at a distance of 20 inches from a Coolidge tube operated on an induction coil. For protection against secondary radiation the plate was laid on a sheet of lead $\frac{1}{8}$ inch thick, while the upper surface was also covered with lead except for a hole through which the rays fell upon the sample of steel. The tube was run with equivalent spark-gaps of 11, 13 and 15 inches respectively, and the results showed that the effective penetration of the rays is greater for the 13 inch gap than at 11 inches, but that it is sensibly the same for the 13 and 15 inch gaps. In the latter case, however, the exposure required is much less. For a spark-gap of 15 inches the following exposures are needed: thickness, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$ ins., exposures 0, 8, 2, 6, 18 and 45 milliampere-minutes respectively. For a 13 inch gap the above values should be increased by 50 per cent. It is considered impracticable to deal with greater thicknesses than $1\frac{1}{2}$ inches of steel, and results must be obtained photographically, no fluorescent screen is sufficiently sensitive to be of use. With regard to the sensitivity of the method it is found that an air inclusion of 0·02 inches thick could be detected in a $1\frac{1}{4}$ inch steel plate, while for a plate $\frac{5}{8}$ inches thick inclusions as small as 0·007 inches in thickness were just apparent. W. F. H.

REVIEW.

The Roentgen Diagnosis of the Alimentary Canal. By Russell D. Carman, M.D. and Albert Miller, M.D. With 504 original Illustrations. (Philadelphia and London: W. B. Saunders Company. 1917.)

This book is written by two authors in collaboration. The writers are respectively head and first assistant of the Section of Roentgenology, Division of Medicine, of the Mayo Clinic. Dr. Carman is Professor of Roentgenology (Mayo Foundation), Graduate School of Medicine, University of Minnesota. Dr. Miller is a Fellow of Roentgenology at the same school. This collaboration has resulted in the production of a book which very fully enters into the analysis of the subject which forms the title of the publication. It is comprehensive, clearly written and excellently illustrated. The writers, as would be expected from their large experience, exhibit a wise restraint in dealing with the many complex clinical problems which they have been called upon to investigate—this is particularly noticeable in the interpretation of the radiographic evidence in its relationship to the clinical investigations which have been carried out as a part of the routine examination. As is to be expected from an institute equipped like the Mayo Clinic, in every detail, nothing is left undone which is likely to have a bearing upon the difficult question of correlation of findings, clinical, chemical and radiographic. An attempt is made to obtain from these investigations the utmost value from each; we think the authors have succeeded admirably and have produced a book which must have a lasting value for all who are interested in the elucidation of complex clinical problems. Particularly is this apparent in the interpretation of the results obtained by the systematic use of the methods of radioscopy and radiography. The book, together with the many illustrations which appear in the text, forms a very valuable addition to the literature of roentgenology. No undue claim is made for these methods of investigation which cannot be substantiated by actual demonstration, and the writers exhibit admirable judgment in estimating the value of each in the final summary of each case. In other words, radiography is given full value as an aid in the diagnosis of disease of the alimentary tract, but it is not regarded as in any way the only absolute method of diagnosis; that is as it should be. Clinical and other methods of examination must always be given a full share in the investigation if the best value is to be obtained.

General technique is fully dealt with, full details of the methods employed at the Mayo Clinics and several useful charts are given to illustrate these methods.

A useful chapter on interpretation well illustrates this important subject, fallacies in diagnosis are pointed out. The following statement from this chapter should be carefully pondered by clinician and radiologist: "It follows, then, that somewhere and somehow the roentgenologic findings should be correlated with the clinical as well as all other data. How shall this be done?" This is well discussed.

Particularly interesting are the chapters on the Œsophagus, Syphilis of the Stomach, New Growth of the Stomach, Simple and Malignant Duodenal Ulcer, Gall Stones, Chronic Appendicitis and miscellaneous lesions and conditions of the stomach.

The work is a valuable record of a systematic investigation of the diseases of the intestinal canal and should rank as a standard text-book on the subject.

NOTES AND ABSTRACTS.

RADIO-DIAGNOSIS.

The Roentgen Diagnosis of Pulmonary Tuberculosis.—H. K. PANCOAST (*American Journal of Roentgenology*, September, 1917, p. 462).—Radiologists, in the author's opinion, are now fairly well agreed that early pulmonary tuberculosis may manifest itself in three ways, depending on the anatomical distribution of the disease—the hilus lesion, peribronchial infiltration along the larger subdivisions of the bronchial tree, and infiltration in the parenchyma around the bronchioles and their terminations. In addition, there are certain recognisable end results as consolidation, cavity formation, bronchiectasis, fibrosis and calcifications, and certain complicating conditions as empyema and pneumothorax.

(1) *Hilus Lesions.*—The radiogram may show an increase in the hilus shadow on one side or possibly both, either more or less homogeneous throughout, or with suggestions of glandular enlargements added. This appearance may be found in other conditions, such as dust inhalations, or be found in apparently healthy individuals, so that the diagnosis must be based primarily on the clinical aspect of the case.

(2) *Peribronchial Infiltration.*—The usual appearances are a thickening of a bronchial trunk shadow extending upward from the hilus towards the extreme apex or outward between the shadows of the anterior portions of the first and second or the second and third ribs, with possibly some fine mottling of visible tubercle shadows in addition. A diagnosis cannot be made solely from such an appearance, as isolated thickened bronchial tree shadows in the upper branches are extremely common in the chests of healthy persons working in inorganic and coal dust, and also following whooping cough and influenza. Fine mottling along the thickened trunk shadow is, of course, more significant, but even that is not pathognomonic. Without the finding of tubercle bacilli, the radiographic appearance cannot therefore be regarded as undoubted evidence of tuberculosis.

(3) *Lesions in the Parenchyma.*—This implies the presence of shadows of visible tubercles in the regions of the bronchioles

and their terminations, where the shadows indicating bronchial trunks have ceased or have become fine lines. Pancoast thinks this is the only type of lesion that can be regarded as presenting a typical appearance. There are exceptions, however, and the small shadows indicative of visible tubercles may be simulated by inorganic and coal dust inhalations, blastomycosis, and other mycotic infections. The author believes that a radiographic examination offers the greatest aid in the doubtful case showing suggestive clinical symptoms and indefinite or doubtful physical signs but with no organisms in the sputum. If the radiograph shows fairly typical evidence of a tuberculous lesion, it is reasonably safe, he says, to base a positive diagnosis on it.

Pancoast believes it is unsafe to assume that the activity of the lesion can be definitely determined by the radiographic appearances. Furthermore, active and quiescent lesions are frequently co-existent. Activity must be determined clinically. He does believe, however, that chronicity can frequently be determined by the amount of fibrosis present.

As regards fibrosis, this is not a condition peculiar to tuberculosis but may follow many other pathological and semi-pathological processes. To settle that an appearance of fibrosis is of tuberculous origin, one must prove an antecedent tuberculous history, or be able to demonstrate the typical appearances usually indicative of a tuberculous process along with the evidences of fibrosis. In his experience, an occupational history is as important as a tuberculous one in a case of fibrosis.

R. W. A. S.

Diagnostic Points in Suppurative Diseases of the Ribs and Sternum.—E. G. Beck (*Amer. Jour. of Roentgenology*, Oct., 1917, p. 491).—Studying the causes of failure in the treatment of these conditions, the author finds the most frequent is that one or more diseased ribs had been overlooked during the operation. This was not, however, always the fault of the surgeon, because on exposure the rib very often appears perfectly normal on its surface, the disease being confined to the cancellous channel of the rib, or to its under surface.

Beck's method of procedure in diagnosis is as follows:—The sinuses, some cases may have as many as ten, are first injected with bismuth paste and stereoscopic radiograms taken. The sinuses are thus clearly outlined and traced into the diseased bone cavities. In some instances they are seen leading into three or four ribs and the sternum; at other times all the sinuses may join and penetrate only one rib, thus indicating the origin of the disease. Sometimes the injection is sufficient to cure the disease, three out of fifteen cases not requiring any surgical interference whatever after the injections, but the remainder required very extensive operations, consisting in the elimination of every vestige of disease, no matter how far it extended. The operative technique is very much facilitated, because the operation could be done according to a definite plan disclosed by the radiographs.

It is pointed out that curetting the sinuses by introducing the curette through the soft tissues and scraping in all directions without ocular inspection of the cavity is working in the dark, and the author considers it absolutely essential to have the sinuses injected and stereoscopic radiographs taken in every case before an exploration is decided upon.

R. W. A. S.

Bone Changes in Leprosy.—J. A. Honeij (*Amer. Jour. of Roentgenology*, Oct., 1917, p. 494).—This investigator reviews at length the opinions of other observers of the various bone changes found in this condition, and appends a bibliography of the literature.

In summing up their observations on the pathological changes in the nervous system he finds:—

(*a*) Both the central and peripheral nervous system are directly attacked and affected by the bacillus in the nerve form of leprosy.

(*b*) Since such nerve function is interfered with, and as a direct result there is bone nutrition disturbance.

The author then describes and illustrates eleven cases of his own in their clinical and radiographic aspects, and summarises his observations as follows:—

Notwithstanding the stage of the disease, or even the type, very definite lesions varying in intensity and extent are found, apparently irrespective of the general condition of the patient. Every case showed bone and bone salts absorption to a variable extent. Periostitis is common. Among these cases there are bone changes which evidently arise primarily from the medullary portion of the bone and others primarily from the periosteum. In the absorption process the epiphysis suffers first and most. Cyst, or cavity formation, is greatest in the diaphysis. Ankylosis occurs, but not healing of fractures, in which salt deposit is necessary. Ulceration of the skin is not necessary, as marked periostitis occurs without any discoverable lesion in the tissues outside the bone. Definite atrophic bone changes, without apparent change in the contour of the phalanx and periosteum do occur. Atrophic bone changes occur in cases of nodular leprosy, demonstrating the fact that definite nerve disturbances are as much a part of nodular leprosy as inflammatory bone absorption is a part of the process in nerve leprosy. Not in a single case can it be definitely said that the destructive bone process arises internally or externally, for in a single case a periostitis may exist in one phalanx, while in another phalanx the changes are wholly medullary. A point of great interest is that in cases where skin ulceration did occur there was no appreciable added change in the underlying bone.

In general, the bone changes observed vary from slight thinning, atrophy or periostitis to advanced changes with total absorption of phalanges, marked inflammatory action in bone, distortion, ankylosis, and fractures. Changes may begin in the periosteum, articular surfaces, cortex, or medullary canal, and apparently any or all of these changes may occur in the same set of bones. The bones of the hands and feet show the changes soonest and to the greatest extent. The tibia was in one case markedly affected, but in a number of cases the ankle joint bones were not affected. A curious exception in the hands was the thumb, the bones here being in but a few cases slightly affected. As has been inferred, the changes expected in the nerve type are atrophic, and in the nodular type inflammatory or hypertrophic. In a few cases the reverse has occurred and both types of changes have appeared in each form.

The causes of the bone disturbances are not agreed upon by observers, but it is agreed that the constant inflammation and infiltration of the nerves, in nerve leprosy, definitely interferes with their function. Bacilli in the blood and in the bone marrow also undoubtedly cause inflammatory disturbances with resulting changes in the structure of the bones. But it is doubtful whether the mere presence of bacteria will produce the rarefying changes. Nerve disturbances produce atrophy, as shown in the nerve cases, but do not produce the irregular bone absorption without diminution in shape or form, as seen in the nodular cases. In some cases there is no outward indication of nerve involvement, yet the bones present changes which are ascribed to nerve disturbances. In some cases absorption has followed atrophic changes. Bacteria produce the osteomyelitic and periostitic changes, and such evidence is presented. The distinctive features of cavity formation described by Deycke have been found. Changes in the periosteum, however, may be mistaken for the irregular absorption changes in the cortex seen sometimes in the diaphyses of the phalanges.

The author states tentatively that there are two new points to be considered: that the absorption of bone and bone salts is an early metabolic change, and that atrophic bone changes with tissue absorption, if wholly due to nerve involvement, are necessarily earlier than outward manifestations, and much earlier than has been hitherto realised.

Studies of metabolism in certain diseases in which bones are affected, such as osteomalacia, are well known, but are wanting as yet in leprosy. The explanations given as to the cause of the bone changes in leprosy do not explain satisfactorily all the changes described. It therefore seems essential to undertake complete metabolic investigations on this condition.

In the examination of the urine, in twelve cases, sodium chloride was found in all cases to be in excess of normal by approximately 1 part per 1,000 by weight, phosphorus and sulphur by approximately 0·5; calcium, magnesium and sodium were present in all specimens, also albumen and nitric acid. In a case of nerve leprosy the urine was examined, previous to radiographic examination, and the calcium content was found to be double the normal. The radiogram showed marked absorption of the bones, especially of the fourth and fifth phalanges. R. W. A. S.

RADIOTHERAPY.

Heliotherapy and X-rays in the Treatment of Surgical Tuberculosis.—H. J. Gauvain (Reprinted from *Proceedings of the Royal Society of Medicine*, Section of Electro-Therapeutics, Vol. XI, No. 2).—The modern conception of surgical tuberculosis, which permits these methods of treatment being logically employed, was outlined. Stress was laid on the importance of the "soil" of the patient with reference to the infection, and particular emphasis laid upon the desirability of regarding heliotherapy and X-ray therapy merely as adjuvant methods in the conservative treatment of surgical tuberculosis, and not as substitutes for other methods of known and proved value. The theories of the action of sunlight on patients the subject of tuberculous disease were discussed, Rollier's views being given special prominence. Evidence was adduced to show that the action of sunlight might be conveniently regarded from two standpoints: (1) Its local or direct action, the benefit of which was confined to superficial lesions by its local bactericidal effect, combined with the favourable inflammatory response which carefully graduated exposure elicited; and (2) its remote or indirect action which induces favourable constitutional effects and benefits deeply-situated lesions. Ultra-violet radiation has little penetrative power. It has the property of inducing in certain patients a deposit of pigment in the skin, which pigment may have the power of transforming the energy of ultra-violet radiation into some form of chemical energy. There was a considerable mass of evidence that such transference of physical energy occurred in plant life, where the transforming medium was represented by chlorophyl pigment. On the other hand, pigmentation had an important protective rôle. Pigmented patients suffered much less from exposure to heat or cold than those in whom pigment formation did not take place. It was well known that the long-waved rays had considerable penetrative power, but in the absence of pigmentation exposure to these rays was not well tolerated. It was conceivable that under suitable conditions they might be of very great therapeutic value. The physiological properties of these rays demanded careful investigation. Their employment, after pigment formation had been induced by ultra-violet radiation, was advocated. Ultra-violet rays of shorter wave-length than found in the solar spectrum had not been proved of value, might be harmful, and should be screened off during exposure emanating from artificial sources.

The remote beneficial effects of sunlight appeared to be dependent on the ability of the skin of the exposed patient to pigment satisfactorily. While ultra-violet radiation induced pigment formation, another factor or factors were concerned, which were inherent in the patient and varied widely in degree. Equal exposure in different patients induced very varying degrees of pigmentation, and in some there appeared to be absence of pigmenting power. In these latter the direct effects of light therapy were produced as easily as in pigmenting patients, but the remote effects were unobtainable. Sandy- and red-haired subjects attacked by tuberculous disease often had little pigmenting power. Freckling would often occur, but deposition of pigment was only obtainable with great difficulty or not at all. Freckling was undesirable, as its formation was not associated with any improvement. It was not necessarily confined to the "red-haired" type of cases, but was commoner in these. It was noted that failure to induce pigmentation was often associated with latent tuberculosis, even though there were no clinical signs of active tuberculous disease. Subsequent development and successful treatment of a hitherto unsuspected lesion was frequently associated with acquirement of pigmenting power, which then was coincident with rapid improvement, both general and local. This observation was therefore deemed to be of great prognostic significance, and corresponded to a somewhat remarkable extent with observations the author had made on the prognostic significance of the von Pirquet test. Pigmenting power appeared to be to some extent a measure of resisting power. Pigmentation was not necessarily synchronous with improvement, but was very frequently associated with amelioration of the disease, and to such an extent that its significance could not be overlooked, and was not coincident nor accidental. Insolation was regarded as an adjuvant method of treatment which accelerated and consolidated the cure. Viewed as a whole, patients did much better in the summer when exposed to sun treatment than in the winter. In the after-care of patients occasional courses of insolation might advantageously be prescribed, as it appeared to reduce danger of relapse and increase the patient's power of resistance.

The constitutional effects of insolation had been described with some degree of fullness by Rollier. It had a marked tonic and psychological effect. It speeded up metabolic activity. Oxygenation was increased, but the respiration rate diminished. There was increased elimination, which was of value in the discharge of toxic products. There was a profound effect on the blood-stream; increased formation of red cells, increase in hæmoglobin content and leucocytosis had all been noted. On even the deepest lesions marked improvement had been recorded. Sinuses frequently dried up where other methods of healing failed. Sequestra were often painlessly extruded. Fibrous tissue generally when not needed was absorbed, and this property was of special value in restoring mobility to healed joint lesions long fixed by fibrous ankylosis.

Heliotherapy in surgical tuberculosis was contra-indicated: (*a*) For its remote effects where there was absence of pigmenting power; (*b*) in amyloid disease; (*c*) in certain acutely septic cases until improvement by other means had been first effected.

The precautions to be observed in the application of heliotherapy were then outlined, and a printed table of rules to be observed by patients taking the sun cure was exhibited. The possible dangers of over-exposure were detailed and the measures to be applied for their relief described.

X RAYS IN THE TREATMENT OF SURGICAL TUBERCULOSIS.

The indications for the employment of X rays in the adjuvant treatment of surgical tuberculosis were discussed, and the importance of careful technique and the selection of suitable cases emphasized. The desirability of working on definite lines and with limited dosage, as suggested by Iselin, was noted, and Iselin's table of tolerance had been observed in the treatment of the cases referred to. The observations made were summarized as follows:—

1. X-ray treatment was of great help in certain local conditions, and, synchronous with their amelioration, general improvement was often observed and maintained.

2. Its value and applicability varied in different regions of the body.

3. It was useful in certain cases of sinus formation and in the treatment of many tuberculous ulcers, leaving supple, non-keloidal scars.

4. It was especially valuable in certain cases of tuberculous adenitis, but the greatest benefits might usually only be anticipated if associated with other methods of treatment. It was particularly useful where there was much periglandular infiltration, and here formed a useful treatment preliminary to extirpation or aspiration. Aspiration, with or without the employment of modifying fluids, was to be preferred to extirpation, when possible.

5. It was most safely applied in tuberculosis occurring in the neck, elbow-joint, and knee-joint. In tuberculosis of the hands and feet great care was desirable in its employment, but with limited dosage, and adequately screened exposures, its use in such cases was often associated with remarkable improvement.

6. It was apparently helpful in certain cases of caseous abscess formation.

7. It was both unnecessary and undesirable in the treatment of abscesses which could be easily aspirated, and should not be used with abscesses which leaked from an aspiration puncture which had resulted from faulty technique.

8. Its employment was attended with danger in abdominal tuberculosis, and was apparently of little value in costal tuberculosis.

9. Obviously its employment was contra-indicated in tuberculous disease of the genital organs.

10. Possible untoward effects as the result of careless technique, or too frequent exposure, should always be borne in mind and guarded against.

11. While frequently of great assistance in the treatment of specific lesions, other aids to

treatment were often required and should be associated.

The paper was illustrated with numerous lantern slides and autochromes, and details given of cases.

Treatment of Wounds Involving the Mucous Membrane of the Mouth and Nose.—P. P. Cole (*Lancet*, Jan. 5th, 1918, p. 11).—The author records the use of the epilating effects of X rays in the use of plastic skin flaps on the face, and thinks that such valuable assistance may be obtained that facilities for radiation treatment should be provided at any jaw centre or hospital.

R. W. A. S.

The Treatment of Fractures in Warfare.—Sir W. A. Lane (*Lancet*, Jan. 5th, 1918, p. 4)—In considering the danger of embedded organisms in the treatment of compound fractures, Lane believes that radium or X rays suitably applied previous to operation might serve to sterilise cicatricial tissues.

R. W. A. S.

RADIO-TECHNIQUE.

The Localisation and Removal of Foreign Bodies by the Combined Method of Radioscopy and Operation.—R. Knox (*Lancet*, Jan. 19th, 1918).—The author reviews and discusses the numerous methods of localisation in use at present and regards their number as clearly indicating the need for standardisation, not only of method but of apparatus as well. He believes one of the chief reasons of failure to find a foreign body after it has been localised is that the radiologist has failed to provide the surgeon with a mental picture of its exact position and its relationship to neighbouring anatomical land-marks.

Of the methods where the surgeon and radiologist collaborate, the writer thinks the most satisfactory is that of combined work in the operating room. The chief essentials for properly carrying out this method are considered at length and suggestions are given for a new table to meet these requirements, and constructed, with modifications, on the lines of the Mackenzie Davidson localising table and the Ironside Bruce director couch.

The author deals with this wide subject from the point of view of both surgeon and radiologist, and this paper deserves the careful consideration of both.

R. W. A. S.

Greater Certainty in the Localisation of Foreign Bodies in the Eye.—J. G. Van Zwaluwenburg (*Amer. Jour. of Roentgenology*, Oct., 1917, p. 512).—After discussing the various errors that may creep into the calculations of Sweet's method, the author advocates the making of three different exposures on the plate instead of the usual two, the tube in the caudal position for the first, the cephalad position for the second, and the median position for the third.

The most important advantage, it is claimed, lies in the fact that it furnishes three separate triangulations for the localisation of every point instead of one. In the reconstruction, the projection lines should meet at a common point, representing the position of the foreign body. If they do not, there has been an error, either in the centreing of the tube, in the reconstruction, or in the fixation of the eye. The diagram will show a small triangle, and the size of the triangle measures roughly the degree of the error. If the triangle is very small, the examination may be accepted as satisfactory; if not, it should be repeated. If properly carried out, the method allows of a definite solution, no matter how large the number of the foreign bodies, from the fact that it requires the simultaneous intersection of three lines to determine the position of a shadow-producing object.

The author can see no serious objection to this modification of Sweet's method. If one of the shadows is lost in that of the dense temporal bone, it is no worse than with two exposures, since localisation is still possible. It also allows the operator to prove up on the technical end of the work, to demonstrate the adequate fixation of the eye, or the lack of it, and in the latter case allows of a fair approximation to the truth in case of necessity.

R. W. A. S.

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NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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A CONSIDERATION OF THE VARIOUS METHODS NOW AVAILABLE FOR HEATING THE FILAMENT OF A COOLIDGE TUBE.

By Francis Hernaman-Johnson, M.D.
London: Hon. Capt. R.A.M.C.; late Consulting Radiologist, Aldershot Command.

The Coolidge tube, which has now been before the radiological public for about four years, has at a single bound reversed the relationship which so long obtained between the X-ray bulb and the high tension generator. Formerly, it was not possible to use the maximum power available; now, for commercial work, such as examining for flaws in metal, it is being found necessary to create special apparatus in order to utilise to the full the capacities of the new tube.

Apart from the question of rays issuing elsewhere than from the focal point—which it is not the purpose of this paper to discuss—there is only one particular in which the Coolidge tube is less convenient than the older type. A low tension current is required to heat the tungsten spiral, which, when incandescent, supplies electrons to carry the high tension discharge. Up till quite recently, the heating arrangement has been as follows:—A 10-12 volt battery of accumulators supplies the current. These are insulated on a stool with glass legs, and the regulating resistance is controlled by a long vulcanite handle. When the tube comes into action, the whole stand is, of course, raised to a high potential; and, if any part of it, except the vulcanite handle, be inadvertently touched by the operator, he receives a violent shock owing to a portion of the high tension current earthing through his body. While this accident is not very likely to occur in a good light, it is very difficult to avoid during screening. Now, the facility with which the hardness of the Coolidge tube may be modified at will during a screen examination constitutes one of its great advantages, enabling us, by the simple process of turning a handle, to pass from the penetrating rays necessary for opaque meal examination in a stout subject to the soft radiation best suited for the lungs of a child. The expectation, not unjustified by experience, of becoming inadvertently a lightning conductor, interferes, however, to a considerable extent with the free use of this privilege. Accumulators, moreover, require a great deal of care. If they do not receive it they are apt to fail at critical moments—such failure being heralded by rapid hardening of the tube and alarming discharge across the spark gap. In short, the present writer cannot imagine anyone depending on accumulators if he could, without loss of efficiency, dispense with them.

Fortunately, it is now possible to eliminate the accumulator battery, except, of course, in the rare instances where storage cells charged at a distance are still depended on as the sole source of current. The various combinations of supply and high tension generating apparatus which are in common use all permit of heating the filament by mechanically produced currents, and may now be considered *seriatim*.

1. *High Tension Transformer Excited by Alternating Current Main.*—The presence of an alternating current of comparatively low voltage and practically unlimited amount makes the problem of heating a very simple one. It is only necessary to place the filament in series with the secondary of a small "step-down" transformer. This secondary is, of course, raised to a very high potential when the tube is in action, and must be effectively insulated from its primary. A thick vulcanite tube will serve, but oil is preferable. Regulation is carried out by varying the amount of alternating current in the primary of the small transformer. An empirical scale is provided, which the operator must learn to use in connection with his particular outfit. The control can be handled with perfect freedom and safety, provided that the insulation between the secondary and primary is sound; it is doubtful if *absolute* security can be obtained apart from oil.

2. *Coil Outfit: Alternating Supply: Motor Generator to feed Coil with Direct Current.*—The main a.c. may be used to heat the filament precisely as in 1, or, if for any reason this is preferred, heating may be performed by drawing off some of the direct current generated for the motor generator (see 4), but this is wasteful in many ways.

3. *High Tension Transformer; Rotary Converter; Direct Current Main.*—Here the rotary converter furnishes us with an a.c. of moderate voltage, but not in unlimited amount. A proportion of this a.c. may be used to excite a small "step-down" transformer, as in 1, but a fall in the amperage through the heating filament will occur at the moment when the circuit is closed through the primary of the large h.t. transformer, and thus the tube will harden. The amount of this drop can be learned and allowed for, but there is a permanent loss of current available for production of X rays.

When a.c. is used direct from the mains through a heavy cable—as in 1 and 2—this preliminary fall does not occur, as the amount of electrical energy available is, for practical purposes, unlimited.

To avoid loss in the case we are considering it should be possible to heat the filament from the d.c. mains, as described presently under 4 (*b*) and (*c*). There are, however, some special features about the problem which the present writer has not as yet had time to consider fully.

4. *Coil; Interrupter; Direct Current Mains.*—(*a*) The accumulator battery has two characteristics which permit it to be readily used to heat the Coolidge filament: it supplies a current of low voltage and sufficient amperage; and, being self-contained, it is readily insulated from the ground. The most obvious way of supplying a mechanical substitute dependent upon the mains is to place upon the same platform a small dynamo capable of the same output, and to drive it from a motor by means of a long vulcanite driving rod, or a rubber band. This is perfectly feasible, and much more reliable than the accumulators, but it introduces more moving parts, and fails to make the control stand any less dangerous in the dark.

The latter difficulty may be got over in either case (*i.e.*, either with accumulators or small dynamos), by earthing the negative pole of the coil, as recommended and illustrated by Messrs. Shorten and Barnard in the ARCHIVES for August, 1917. Where this is done, the whole negative side of the tube becomes "dead" so far as high tension discharge is concerned. But if we decide to run the coil with the negative earthed—a procedure which has the additional advantage of minimising inverse current—there is nothing to prevent us dispensing with the motor and dynamo, and heating the filament directly from the mains through a resistance.

(*b*) Before discussing this further, I wish to mention that a method has been perfected by Dr. Jordan in which a small motor magnetic break is used to furnish what is virtually alternating current to a small transformer, after the method described under 1. The present writer has seen this working smoothly and efficiently.

(*c*) The detailed arrangement for heating from the ordinary d.c. three-wire system was fully gone into in an article by the present writer in the November ARCHIVES (1917). Once the connections are made, no further adjustment is needed, and there are no moving parts to get out of order. The essential point to grasp is that the negative pole of the coil is not earthed in the ordinary way to a gas or water pipe, but to the *central earthed wire* of the three-wire system. This wire may be simply determined by taking an ordinary reading lamp with a pronged plug, and twisting the bared end of a long piece of flex around each prong. (A piece of cork should then be jammed in between the prongs to prevent a possible short.) The flex ends distal from the lamp are also bared, and one is wound round a gas or water pipe. The other is then placed in one of the openings of the female wall plug. If the lamp does not light the wire is transferred to the other hole, when it will glow if the connections have been soundly made. The side of the plug which, when placed in connection with the earth through the lamp and gas pipe, failed to result in any illumination is, of course, itself on the earth side of the system. On the control trolley there should be a special terminal, labelled "earth for negative High Tension wire," which is in electrical connection with the earthed side of the wall plug. The wiring between the trolley and the wall plug, once arranged, is better not disturbed; but if it is necessary at times to use the plug for other purposes, some method should be adopted by which it is made impossible to put the male plug from the trolley in with reversed poles.

We are now in a position to consider the merits and demerits of the several systems of heating in various circumstances.

(1) Where alternating current is available from the mains there can be no doubt but that a small transformer, with oil insulation between primary and secondary, is the best device for heating the Coolidge filament. There are no moving parts, no drop in the heating current takes place on throwing in the main switch, and the waste of current is reduced to a minimum. The arrangement is equally applicable with a (high tension) transformer or when alternating current is used to drive a motor generator, which in turn supplies a coil. I have seen the system in use under the latter circumstances now for several months at the St. John's Hospital, Lewisham, and can testify to its efficiency and convenience.

(2) When alternating current is available only from the rotary converter of a high tension transformer. Here, unless the converter is a very large one, an appreciable drop in the heating current occurs at the moment when the main switch is thrown in, and current is also used up which would otherwise have been available for the direct production of X rays. It may prove to be possible to heat directly from the mains by grounding the negative side of the transformer, after the manner previously described in dealing with a coil outfit.

(3) Where only direct current is available. Choice here lies between the use of some device after the manner of that perfected by Dr. Jordan, and the "direct method" favoured by the present writer. The Jordan system is a good one, but it involves the keeping in order of a second mercury interrupter. (See ARCHIVES, March, 1918.)

I now come to some of the objections urged against the "earthed system." Of these the most trumpeted appears to be a statement that coils will not "stand up to it." My own experience, which now extends over six months, during which time many hundreds of treatments have been given, and much screening and radiographic work carried out, agrees with that of Messrs. Shorten and Barnard—that, at any rate so long as half the nominal spark length of the coil is not much exceeded, no apparent harm results. Also, the manufacturers admit that at an additional cost, amounting to not more than 7 per cent. of the present price of coils, it would be possible so to increase the insulation between primary and secondary that they could be guaranteed against breakdown under all circumstances. With the existing coils, half the nominal spark gap may be taken as absolutely safe ; in my own work I have, as a matter of fact, often exceeded it by 2–3 inches, *i.e.*, to the limit of what is permissible with a Coolidge tube. This argument against the system cannot, therefore, be taken seriously.

More worthy of being considered, in my opinion, is the fact that "brushing" from the positive high tension lead is very much increased, and there is more crackling evident for a given equivalent spark gap than when the negative is not earthed. This phenomenon does not call for any particular measures up to about 6 inches spark gap, and it need not therefore be considered in connection with fluoroscopy and radiography. When an 8–10 inch gap is to be used, special care must be taken with the insulation of the positive lead. It is usually sufficient to see to it that high tension wire is at least 12 inches away from any conductor connected with the earth, but if the whole positive lead can be enclosed in a rubber tube brushing and crackling is very much reduced.

In treatment, if it is desired to use very hard rays, the anode of the tube must either be kept at least 12 inches from the patient, or, what is better, a protective extension should be fitted to the tube box, if this is of the ordinary type, with the tube ends projecting. The Coolidge tube has the fault of scattering rays very freely, so that the extension may well consist of thick lead-rubber, and it is well to fit a similar one under the cathode projection also. This arrangement effectively protects the patient from shock, and from stray radiations in a downward direction, but, unless sides are provided to the extensions, the operator does not gain added safety.

When an adjustable spark gap is used, the coil should be so arranged that the movable part of it is *negative ;* it may then be handled freely. The terminals of the primary, if at the positive end of the coil, will need insulation by a projecting tube of vulcanite ; otherwise, sparking may occur between them and the positive terminal of the secondary.

An important point in obtaining smooth running is the speed and cleanliness of the break. With a fast-running turbine jet interrupter, crackling is reduced to a minimum. I have found the Watson "Dreadnought" very satisfactory, and have also used a new model Mackenzie Davidson gas break by Schall ; this works well so long as it is clean and run at top speed, but a turbine is preferable.

If care be taken in the carrying out of all the above details, crackling, etc., may be reduced to a limit not greatly in excess of what occurs under ordinary conditions of running.

Current Waste.—The most economical way of heating the filament is by alternating current and a step-down transformer. The most wasteful is by accumulators, as there is not only the loss involved in charging through a resistance, but also that inherent in changing from electrical to chemical energy and back again. In the grounded pole method, as applied to the three-wire d.c. system, if a series resistance be employed, the wattage consumed is about 800–1,000 on a 240 volt main. With Dr. Jordan's method it is somewhat, but not much, less. If a shunt be employed, which is more compact, and in some ways more convenient, the current consumption is about 20 per cent. higher.

The most economical and simplest method conceivable would be to have the filament of the tube made to withstand 200–250 volts. In this case only a fraction of an ampere would be necessary to heat it, and a single small sliding resistance would be an efficient control. I have been in correspondence with Dr. Coolidge on this matter, and he has courteously explained to me the technical difficulties in the way. It seems that attempts have been made in this direction, but that the filament had to be so attenuated that it would not retain its shape. Dr. Coolidge does not consider, however, that the problem is insoluble.*

In practice, the necessary resistances are mounted on a trolly, which stands beside the diascope. Below is placed the main resistance. On the marble slab are—

(1) Fine resistance.
(2) Amperemeter.
(3) Safety fuse.
(4) Terminals for heating circuit.
(5) Terminal for negative H.T. wire.

In addition to these, I have on my own trolly a small low tension milliampere meter, such as is used in galvanic batteries. This is on the earthed side, and reads quite as accurately as the large H.T. instrument which is mounted near the coil. It is a convenient and cheap addition. It may be illuminated by a faint red light, together with the ammeter.

When preparing to screen, the main resistance of the coil is set at the highest stud which may conceivably be needed for the thickest part of the patient. When examining thin parts, all that is necessary is to increase the heating current, when the hardness of the rays decreases. It is, however, necessary to remember that a very abundant soft radiation is then falling on the patient, and at least half a millimetre of aluminium should always be interposed when screening with a Coolidge tube.

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* A practical point for all users of Coolidge tubes is to substitute as soon as possible stout rubber-covered flex for the silk flex supplied. This soon wears through, and results in a short, which may occur at a very inconvenient time.

The standard pattern Coolidge tube, once its target becomes very hot, is as susceptible to inverse current as any other. A method by which this objectionable current is largely suppressed, while at the same time moving parts are abolished, and the mains directly utilized, is surely worth an extended trial.

ON THE USE OF THE OPAQUE URETERAL CATHETER TO LOCALIZE MISSILES IN THE REGION OF THE KIDNEY AND URETER.

By **Andrew Fullerton, M.D., M.Ch., F.R.C.S.I.**

Colonel (Temporary) Army Medical Service; Consulting Surgeon, British Expeditionary Force.

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It is highly important to be able to say whether a missile which has penetrated the body so as to lie somewhere in the renal region is actually in the kidney or is situated outside that organ. An aseptic missile may perhaps do no harm in the perirenal tissues, but a foreign body in the kidney itself, or near the ureter, ought to be removed. The kidney is liable to vary so much in position that the ordinary general rules that guide one in localizing a foreign body in a solid organ may fail, and much unnecessary trauma may be inflicted in the search for it. Hæmaturia may be due to a missile which simply contuses the kidney without entering it, or it may be due to a foreign body which lies in the organ, or has passed through it. We have found the depth of muscle between the kidney and the skin over the back to be greater in a soldier on active service than in an ordinary male of average size. This increased volume of muscle, due to hypertrophy from over-use, places the kidney at a greater depth from the surface than usual, and renders the use of cross sections of an ordinary average body from an anatomical atlas of doubtful value.

Localization by X rays has reached a high state of efficiency, but, as the case about to be mentioned shows, it can only give approximate results when a mobile organ like the kidney is under consideration. I have recently been using the opaque ureteral catheter combined with stereoscopic radiography to determine the position of a foreign body in the lumbar region relative to the kidney or ureter, with excellent results. The method is not attended with any great difficulty, and can be carried out, if necessary, without a general anæsthetic. A local anæsthetic to the urethra is desirable.

The observation is carried out as follows:—

An opaque ureteral catheter is passed into the pelvis of the kidney on the affected side. We know from experience of pyelography that it usually passes into the uppermost calyx (see Fig. 3). The upper end of the catheter will probably be within $\frac{3}{4}$ to one inch of the upper end of the kidney, as the upper calyx is about that distance, as a rule, from the surface of the upper pole of the organ. The upper end of the catheter will form in this way a valuable landmark as regards the position of the kidney. Collargol may be injected to verify the assumption that the catheter is actually at the extreme upper limit of the pelvis, but this should not be done until the position of the foreign body relative to the catheter has been accurately ascertained, as the shadow of the collargol might obscure that of the foreign body.

Stereoscopic radiographs are taken with the catheter in position, and the antero-posterior relation of the foreign body to the opaque catheter noted. Captain Gamlen, R.A.M.C., has in several cases worked out these relative positions by Mackenzie Davidson's method, and I am indebted to him for his great care and skill in taking radiographs, and helping me in every way with these observations.

The following case will illustrate the method better than any description: Pte. No. 5525 was wounded with a rifle bullet while in the erect position, on March 15th, 1916. The range of fire was not known, but as the bullet was slightly deformed at its apex it is probable that it had ricochetted before entering the patient's body. I am indebted to Captain Meyer for the following brief note taken at a casualty clearing station: The patient was hit in the right side, at 7.30 p.m., and was seen by Captain Meyer next morning at 5 o'clock. After being wounded he had a good deal of difficulty with his breathing. Blood was present in the urine. There was no vomiting. Patient's colour was "not bad." Pulse 93. Right side of abdomen rigid as far as umbilicus. Left side normal. Had a "cold" and a cough before he was wounded. Patient had some fever while at the casualty clearing station, the temperature reaching on one occasion 104° F.

When I saw him, a few days later, with Major West, R.A.M.C., at a base hospital, the hæmaturia had ceased, having lasted about three days, and his temperature was gradually settling. We found a small punctured wound $11\frac{1}{2}$ centimetres above the highest point of the iliac crest on the right side, just behind the mid-axillary line, 15 centimetres from the mid-line of the body, and 5 centimetres behind the level of the anterior superior iliac spine. Worked out on cross sections, the bullet probably passed through the following structures—chest wall, pleural cavity (lower part), diaphragm, peritoneal cavity, liver, kidney.

On March 23rd the urine was free from blood, pus and albumen. Specific gravity 1018. Reaction acid. On March 26th stereoscopic radiographs were taken by Captain Gamlen with the opaque catheter in position. At the same time urine was obtained from both ureters and found to be normal. The specific gravity was found to be equal on the two sides.

Captain Gamlen had previously radiographed the patient and had come to the conclusion that the bullet was in the right kidney, for two reasons. First, the bullet moved slightly with respiration, and second, the depth at which it was located, its distance from the middle line, and its level, corresponded with the position of the normal kidney (see Figs. 1 and 2).

The following report was furnished by Captain Gamlen after radiographing with the opaque ureteral catheter in position :—

The distance of the centre of the anode from the plate, which was on the patient's back, was fifty-three centimetres and the shift of the tube was three centimetres on either side of the central line.

The stereoscopic radiographs (Fig. 1) show that the catheter is in front of the bullet in its whole length.

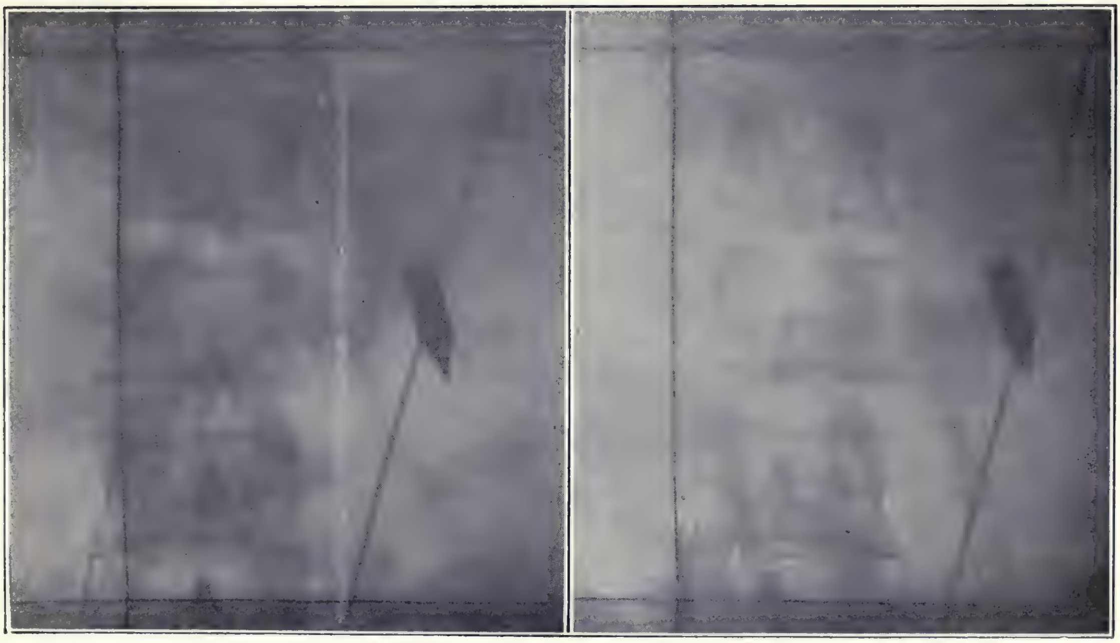

FIG. 1.—Stereoscopic skiagram, showing the position of the missile behind the ureteral catheter.

Measurements of the shadows of bullet and catheter are as follows :—

1. (*a*) The distance of the centre of the base of the bullet from the centre of the spine is 5·6 centimetres. (*b*) The distance of the point of the bullet from the centre of the spine is 6 centimetres.

2. (*a*) The distance of the centre of the base of the bullet from the plate is 7·6 centimetres. (*b*) The distance of the catheter on a level with the base of the bullet from the plate is 9·4 centimetres. Therefore the base of the bullet is 1·8 centimetres behind the catheter. (*c*) The distance of the point of the bullet from the plate is 6·9 centimetres. (*d*) The distance of the catheter at the level of the point of the bullet from the plate is 10·5 centimetres. Therefore the apex of the bullet is 3·6 centimetres behind the catheter.

On referring to the radiogram it will be seen that the base of the bullet is on a line with the upper border of the third lumbar vertebra.

If a cross section of an average male body is taken at this level, and a point is marked on the right side 5·6 centimetres from the mid-line, and 7·6 centimetres from the surface (*i.e.*, from the plate), it will be found to be in the kidney (see Fig 2). The measurements, however, of the distance of the base and apex of the bullet from the catheter prove that if the kidney is of normal thickness the bullet must be outside it. We may take it that the catheter is lodged about the central plane of the kidney. The normal kidney is about 3 centimetres (nearly $1\frac{1}{4}$ inches) thick. If the base of the bullet is 1·8 centimetres (nearly $\frac{3}{4}$ inch) behind the catheter it must therefore be about 3 millimetres ($\frac{1}{8}$ inch) behind the kidney, and the apex farther away still. Captain Gamlen estimated that the point of the catheter was $2\frac{1}{4}$ inches (5·7 centimetres) distant from the bullet, and, assuming that the point of the catheter is, say, $\frac{3}{4}$ to 1 inch from the upper surface of the upper pole of the kidney, the bullet must be from 3 to $3\frac{1}{4}$ inches from the upper pole of the kidney. The kidney is $4\frac{1}{2}$ inches in length, therefore the bullet must be behind the kidney or ureter, at the level of the lower pole.

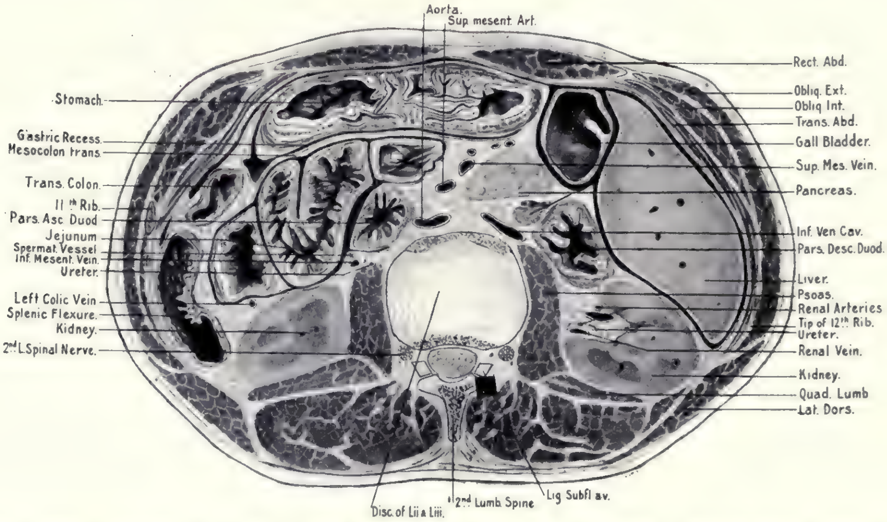

FIG. 2.—Transverse section of a male body at the level of the upper border of the third lumbar vertebra.

Operation on March 28th by Major West and myself discovered the bullet embedded in a large fleshy mass, composed of perirenal tissue, infiltrated with blood, and, possibly, urine. It was lying in a small abscess cavity just outside the kidney, on its posterior surface, at the level of the lower pole (see Fig. 3). The bullet had passed through the kidney near the hilum from front to back. The movement on respiration, noticed by Captain Gamlen, was due to the fact that the large adherent mass of perirenal tissue in which the bullet was lodged moved with the kidney on respiration. The kidney was pushed forward by this large mass, and thus the fallacy as to the position of the bullet, judged solely from its depth from the surface of the back, was easily explained.

We deemed it advisable to remove the bullet, though we were practically certain that it was well behind the kidney, on account of the patient's temperature, which was no doubt due to the small abscess cavity mentioned above.

In a second case there were three shadows of shell fragments in the renal region. Two of these were obviously well behind the kidney, as seen by stereoscopic radiographs with the opaque catheter in position. The third was located by the method just described as lying at the inner margin of the upper pole of the kidney in the position of the suprarenal capsule. Post-mortem examination showed the fragment lying between the upper pole of the kidney and the suprarenal capsule. The missile had grooved the posterior surface of the kidney and come to rest in the position indicated. I have full notes of this case, for which I am indebted to Captain Fitzmaurice Kelly, and there are other features in connection with it which I hope to mention in a later communication on injuries to the kidneys. The case is mentioned here incidentally to illustrate the method of localization, which I suggest may be of value in certain circumstances.

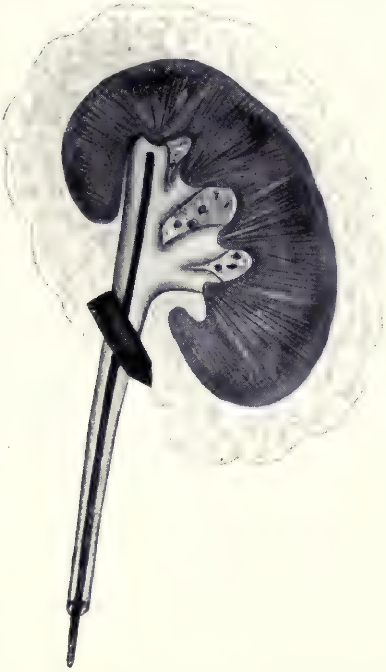

Fig. 3.—Semidiagrammatic section of a kidney showing a catheter passed into the upper calyx, and its relation to the bullet. The infiltrated perirenal tissue is shown surrounding the kidney.

I am indebted to Miss Rea, of the Anatomical Department of Queen's University, Belfast, for the drawing of the kidney illustrating the position of the bullet relative to the ureteral catheter, and for the drawing of a cross section from the Anatomical Department of Queen's University, Belfast, by kind permission of Professor Symington.

ELECTRICAL DEPARTMENT, MILITARY HOSPITAL, TIDWORTH.

By Captain F. Gower-Bergin, R.A.M.C., Medical Officer in charge of Electrical Department.

The above hospital forms a most interesting study of the increasing call for electrical and allied treatments in modern conditions of the army.

This seems to be the general opinion of all those who are working in these departments. The growth of such, when everything gives place to speed in returning a man as fit to his unit, and the wholesale sweeping away of traditional methods in place of those which rapidly render a man fit for service, is an eloquent testimony to their usefulness. Tidworth Hospital is situated in a unique position for studying the value of these methods to the full. It is a large hospital on Salisbury Plain. It stands in the midst of an immense military population, surrounded on all hands by camps, aerodromes, training battalions and service corps. In addition to these, convoys of sick and wounded from the front line are sent in. Thus it will be seen that there is an enormous area to draw upon, and a far greater variety of cases than is usual in a military hospital. Included amongst these are bombing, aeroplane, and cavalry training accidents, and an enormous number of neurites, lumbagoes, myalgias, and sub-acute joint conditions, which are an almost necessary concomitant of life on Salisbury Plain during the winter. Another most interesting branch is the treatment of fractures resulting from both special and ordinary causes.

It will thus be seen that a most interesting collection of cases are presented for observation, varying from acute accidents involving nerve lesions down to chronic myalgias.

In the Electrical Department of this hospital our energies are not confined solely to electrical methods, but any and every form of allied therapy is used which seems suitable, or any combination of them that aids the rapid recovery of a patient. In January, 1916, the compartment consisted of one small room with a little dark room attached. In this the whole work of the hospital X-ray and electro-therapy was done. It soon proved quite inadequate to the number of cases which were attending, and every encouragement was given by our Commanding Officer to extend and improve on existing conditions. The consequence is that we have now a suite of six rooms leading one from another. These are well fitted up with most of the modern requirements for electrical and thermal baths, and for work in physico-therapy.

In addition to this the Massage Department has been moved down to us and now forms one part of the whole concern. This I consider very important. It has been fitted up with a good number and variety of physical exercises and electrical appliances. To get the best results one should be able to use massage, movements with physical exercise, ionisation, heat baths, or any combination of them, one after another, as may be deemed advisable. This enormously adds to the value of each line of treatment. They should in fact be considered as one. Thus they are all combined under one compartment.

PERSONNEL.

Personnel consists of one staff sergeant, corporal, orderly, and two masseuses of the Almeric Paget Corps, with M.O. in charge. The work starts at 9 a.m. and goes on till about 5 p.m. Frequently appointments are made late on in the evening for officers whose duties will not allow of their coming during the day-time.

A short history of each case is recorded and filed for reference, and an appointment given. Times are then rigidly adhered to.

ELECTRIC SUPPLY

Is obtained from the power station in the camp. We have both 120 and 240 volts installed. We use the former for galvanism and faradism and the latter for heat baths and X-ray work.

ALLOTMENT OF ROOMS.

1. There is one large room for general treatment.
2. One small room reserved for officers.
3. One large room for massage fitted up with exercises and mechanical apparatus.
4. One small massage room for officers.
5. X-ray room leading out of main room, but quite separate from it, for treatment and diagnosis.
6. Dark room attached.

THE APPARATUS.

The Apparatus consists of :—

1. Two plurostats, with complete Schnee baths for galvanic, faradic, and sinusoidal currents.
2. Lewis-Jones interrupter attached to one plurostat for rhythmic interruptions.
3. Bristow coil.
4. High frequency machine.
5. Full length Trynauer bath, with special adaption for cases of lumbago.
6. Small heat bath for single joints or limbs.
7. X-ray treatment apparatus.
8. Massage rooms with various physical exercises.

It will be seen that our range is very considerable and the possibilities great.

The following gives a short account of the more important lines of treatment carried out:—

X RAYS.

(*a*) *Diagnostically* are used largely in examination of lungs, hearts, intestines with barium meals, and the usual F.Bs. and fractures.

(*b*) *Therapeutically* are used for psoriasis, rodent ulcers, eczema, pruritis.

IONISATION.

Under this heading we have had excellent results with the following class of cases:—

(*a*) *Neuritis* (chiefly brachial).—The acute cases generally do excellently. I find best results are obtained by a combination of ionisation and radiant heat. We usually put the whole arm in a bath and ionise with sod. sal. up to 70-80 m. amps. for half to three quarters of an hour. The more I see of this method the more convinced I am of its therapeutic use. But to obtain results, large currents for prolonged periods must be used. If the skin gets at all sore we change to radiant heat. After each application a dusting powder of zinc, starch and boracic acid is used. This is very soothing.

(*b*) *Fibrositis of Joints.*—Excellent results have been obtained in stiff knees and elbows by combined efforts. Joints are painted with iodine and ionised with sodium chloride. After three or four applications this is replaced with heat baths and the limb cooked up to about 250-300 F. Immediately after each application vigorous movements of the limb are attempted by the masseuse. Excellent results are obtained by doing this while the limb is thoroughly hyperæmic as a result of the treatment.

(*c*) *Synovitis of Joints.*—In these cases the best effect is obtained by ionising with pot. iodide or iodine and sod. sal. A large number of acute synovitis of the knee with fluid have come under treatment on these lines, and rapid recovery is the general rule. The relief of pain and tension is great. If one gets the cases in the acute stage no other line of treatment can compare with the results obtained.

(*d*) *Sciaticas.*—As a rule are disappointing. One rarely gets them in the acute stage. Men put off treatment as long as possible, and they only reach us in the chronic stages. If they were sent on the first acute attack I think results would be greatly improved.

(*e*) There are numerous cases to which it would be difficult to give a name, various aches and pains, myalgias and neuralgias or joint pains of indefinite origin which are undoubtedly helped by ionisation. The relief given is generally quick and permanent.

RADIANT HEAT.

Here we use the Trynauer baths. We have two—one small one in which limbs are cooked, and one large one. This is a special bath made up to my own device. In it we can put a patient from the feet to above the hips. By allowing the feet to protrude at one end we can get him in from the knees to the neck. By a simple contrivance the upper end of the bath folds back, and a specially fitted seat is inserted, which enables the patient to sit in it, while the whole of the back from the neck to buttock is exposed to the heat.

This bath has been invaluable to us, and is in use the whole day. In the full length bath we treat sciaticas and sub-acute rheumatisms. In the sitting bath lumbagoes. In this last class of case we have had remarkably good results. In acute backs almost instant relief is given, and a cure usually effected within four or five days. You can practically promise a cure if you can get the cases in early stages. We have had men sent in to us who were in such pain that there was considerable difficulty in getting them into the bath. After an hour's cooking they could dress with some measure of comfort and do ordinary bending exercises. I know of no other line of treatment which can offer similar prospects.

FRACTURES.

Treatment of these cases forms a large and important branch. They are worked on rather unusual lines, but the justification for this is the good results obtained and the saving of time.

Where practicable fractures are sent to us within 24 hours of the accident. First the bandages are removed, and very gentle massage (the glucokinesis of Dr. Mannell) is applied. This undoubtedly relieves pain. Then the Bristow coil is used.

Suppose the fracture is a Colles' of the wrist. The arm is removed from the splint and laid on a flat table on a piece of flannel. The site of the fracture is firmly held in the operator's hand. Applying the electrode very gentle movements of the muscles of the forearm are produced. These movements can be regulated to a nicety by the insertion and withdrawal of the secondary coil, which is the main feature of the Bristow apparatus. These movements are painless, in fact are comforting, and by mechanically reproducing normal actions the circulation is improved, muscle tone maintained, and the repair of bruised material hastened. In a day or so the strength of the applications is increased, so that while still maintaining firm pressure over the site of fracture, gentle flexion, extension, abduction and adduction of the hand is obtained. The advantages of these methods, if started from the beginning, are as follows :—

1. Adhesions do not form and stiff joints are obviated.
2. Muscle tone is maintained and disuse atrophy obviated, so that the full power of the limb is regained at a much earlier date.
3. The time of treatment is generally reduced, and the disability on discharge is far less than that obtained by immobilisation and massage.
4. The weeks that are often wasted to overcome stiffness and wasting of limbs are to a large extent saved.

NERVE INJURIES.

Nerve injuries have supplied a number of cases and have been treated along established lines. We have been using a Lewis-Jones rhythmic interrupter on a good many of them. In my opinion it is the most practical of its kind in use.

HIGH FREQUENCY.

High frequency discharges are not much used. I think its effect is best seen in neurasthenias and shell-shocks. I think benefit is sometimes obtained in such cases.

MASSAGE DEPARTMENT.

The Massage Department is all part of the same and is next door to us. The masseuses of the Almeric Paget Corps massage suitable cases directly after the application of radiant heat or ionisation. In my experience it is of great importance to apply massage and movements when the limb or joints are thoroughly hyperæmic as a result of treatment. In this state it is much more amenable, manipulations are less painful, and results obtained are far in advance of similar treatment when applied separately.

It cannot be too strongly impressed that cases should be treated in the early stages of the trouble. A few days then often saves weeks of treatment later, and in many cases staves off permanent disability.

In the Electrical Department of this hospital we strongly advocate the use of any and every device which will render a patient's return to duty as speedy as possible, and in our opinion this is best obtained by a combination of the above-named methods.

In conclusion I have to thank Lieut.-Colonel Faichnie, R.A.M.C., for permission to publish this paper, and still more for the great help and encouragement he has given in the working of the department. Whenever we were able to convince him that any device or mechanism, electrical or otherwise, would hasten the return to duty of the invalid soldier, it immediately had his warm sympathy and support.

FRACTURE OF SESAMOID BONES.

By Major J. HALL-EDWARDS, R.A.M.C.

It is of the greatest importance that every new fact elicited by means of the X rays should be registered for future reference. It frequently happens that radiographers are called upon to examine the metatarsophalangeal joint of the great toe for the purpose of finding the cause of some pain, and up to quite recently I was unaware that a fracture of one of the sesamoid bones in this region might be the cause of much disability. I can find no reference to this injury in any of the textbooks or in any of the books upon radiography, and on enquiry from several surgeons I have been informed that they have not met with this condition.

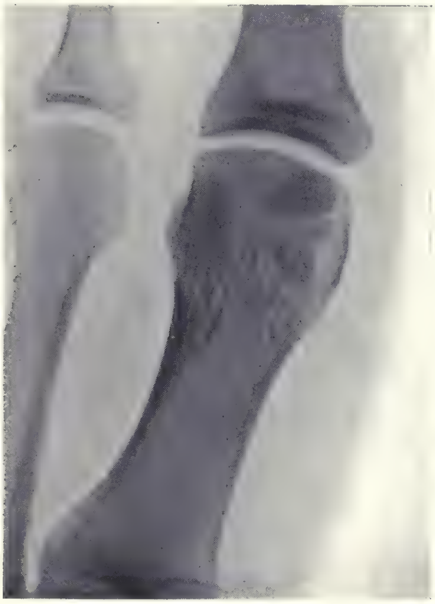

FIG. 1.

Right Great toe.

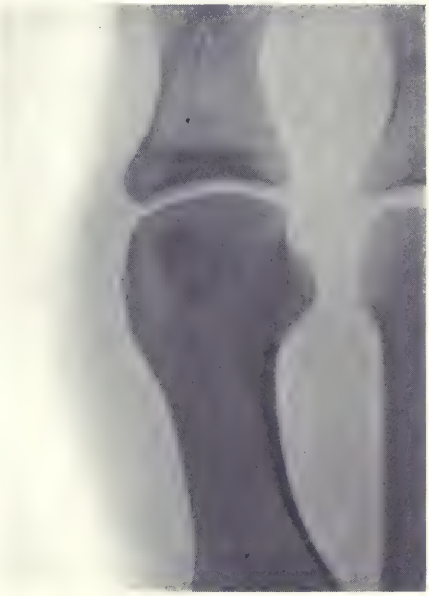

FIG. 2.

Left Great toe.

I have frequently suspected inflammation of the sesamoid bones as a cause of trouble, especially in the case of the bone in the outer head of the gastrocnemius after a severe blow on the knee.

In the case illustrated here, the patient complained in the first instance of pain in the right great toe joint and hip joint, the pain in the latter being due to the fact that he walked on the outside of the foot to relieve the pain in the toe. The radiograph of his hip joint showed no disability, whereas the radiograph of the great toe showed that the internal sesamoid bone in the tendon of the flexor brevis pollicis was in three pieces.

The history of the case is as follows:—When six years of age the patient remembers that his foot was trodden upon by a horse, but he felt no ill effect from it. Five years back, whilst playing football, he felt pain in the foot and ankle and there was a considerable amount of swelling, particularly in the ankle, and he was unable to walk properly for some time. He had massage and electrical treatment, and his foot, as far as he remembers, completely recovered.

Eighteen months back he joined the O.T.C., and after a little training he felt considerable pain in the right great toe on standing, also in the hip on the same side after marching. Two radiographs were taken, one of the hip which showed no disability, and one of the great toe (see Fig. 1). On resting for several weeks the pain partially subsided, when he again went on with his training. After a week or two the pain again returned, and shortly after he felt considerable pain in the left great toe, but found this was relieved by walking slightly on the outside of the foot. He again consulted me. I radiographed both feet, and the condition of the right foot, as far as the radiograph is concerned, showed no improvement—that is to say, there was no union. This we should of course expect, as bony union would not be likely to take place.

The radiograph of the left toe (Fig. 2.) shows that the internal sesamoid bone was in two pieces. The patient does not remember having had any sudden pain or having had any particular strain at any period of his training, but he finds that he is quite unable to walk any distance now without pain and swelling.

It will probably be suggested that this is a case of multiple sesamoid bones and that no disruption of the bone has taken place. From a careful examination of the first radiograph, taken seven months back, there is distinct evidence that the bone of the right great toe has been fractured, as the opposing edges of the fragments are rough and convey the appearance of fracture. This is not so noticeable in the left foot, but in face of the evidence of fracture in the right I think it possible that this is a fracture also.

The case is interesting as showing the possible cause of some of the pain in the great toe in obscure cases; and from the fact that the condition is diagnosable by means of the rays.

REPORT OF SOCIETY.

AMERICAN ASSOCIATION OF ELECTRO-THERAPEUTICS AND RADIOLOGY.

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ABSTRACT OF PAPERS

Read at the Twenty-Seventh Annual Meeting, held at Atlantic City, N.J., September 11th, 12th and 13th, 1917.

Dr. J. Willard Travell, of New York, the President, in the chair.

Presidential Address. *The Influence of the American Electro-therapeutic Association on Electro-therapeutic Practice.*—Dr. Travell outlined and contrasted the crude and in many ways unsatisfactory methods of treatment of the early nineties with modern procedure in the use of physical measures. Credit for the change was given to the discovery and development of more efficient types of apparatus, and scientific study and determination of the exact physiological effects of the various electrical currents. A strong plea was made to bear in mind always the fact that we were using simple physical agencies with absolutely constant and definite action, to discourage the idea that there was mystery in the therapeutic use of electricity, and to endeavour to enlighten the general practitioner as to the fact that he was not doing justice to his patients in not being prepared to give them the benefit of physical therapeutic measures as an aid to other medical or surgical procedures.

The Value of Physical Measures for the Treatment of Wounds and the Traumatic Injuries in the War. By Wm. Benham Snow, M.D., New York.—The writer called attention to the fact that in the treatment of wounds abroad during the war, it has gradually been established that electricity, light and other mechanical measures play a most important part in the treatment of wounds, and traumatic injuries, as sprains and synovitis. The experience of the French and English observers has established the fact that the physical methods, in order to be successfully employed, should be under the management of those who understand the methods of application and not under the dictation either of surgeons or physicians who do not. The writer calls attention to the great value of radiant light in the treatment of open wounds, streptococcic and staphylococcic infections and erysipelas, facts which are not generally realized by the profession. He urges the early use of light following an injury both to promote healing with the hyperæmia produced, and also as a prophylaxis against infection. The use of the static current, as thoroughly established in the treatment of arthritis arising from trauma, and sprains and injuries in the proximity of joints, is earnestly urged. In closing, the writer expressly calls attention to the importance and duty of this Association, who understand the principles of these methods, to endeavour to impress upon the Government the necessity of their establishment in the hospitals in this country and also in the hospitals abroad.

Physical Therapeutics in War.—Dr. **Joseph Riviere**, of Paris, contributed this paper, which was read by Dr. William Benham Snow, New York. The author asserted that, thanks to physical therapeutics and its benefits, the social waste of war could be reduced to a minimum. As soon as the required surgical measures had been completed the wounded of the war should be turned over to the physical therapeutist. Some of the cases treated by the author were: ankylosis, muscular stiffness, retraction, cicatrices, neuritis, atrophy, paralysis, lesions of the nerves, and other conditions for the greater part complicated with arthritic manifestations, and disorders of the nervous system.

The Formation, Equipment and Administration of an Electro-therapeutic Unit for Work Abroad. **Virgil C. Kinney**, M.D., Wellsville, N.Y.—In presenting his paper to the Electro-therapeutic Association, Dr. Kinney stated that the electrotherapeutist and the institutional man with executive ability are just as essential for army work abroad as the army surgeon. Dr. Kinney presented plans for a complete 100 bed unit including buildings, equipment, and administration. This work was placed under two departments:—

(1) A Department entirely separate from hospital work. This to be in a separate building and entirely free from all hospital influence. Here, so-called rheumatism or any of its allied conditions, the nervously depressed and melancholias, the high blood pressures or any toxic conditions may be given an intensive elimination and physical up-building.

(2) A Department occupying a portion of an already existing hospital and working in conjunction with the surgeon. This department should have separate rooms for electrical treatment and bath work, and in addition, much portable apparatus to enable the therapeutist to give his numerous treatments at the bedside.

The buildings are designed with special regard to simplicity of design, comfort, ecomomy in operation, elasticity and mobility. The whole plan is so comprehensive that the Government could well spend some time in going over the work.

Twelve Cases of Anterior Poliomyelitis of the Epidemic of 1916 Intensively Treated.—Dr. **Lucy Osborn Wight**, of New York, told of her experience in treating twelve cases of anterior poliomyelitis after they had been discharged from various New York hospitals. Rational treatment consisted in an attempt to restore all possible power and function to the affected muscles and to restore and improve the invariably disturbed circulation. She said the two most important factors in treatment were warmth and rest. The treatment she had used consisted in radiant light to the spine and affected muscles, and also mechanical vibration to the spine and the affected muscles. After the first three months the static wave current was applied to the spine two or three times a week. Massage and muscle training were used, the child making voluntary efforts to use the limbs in their normal movements. Twelve cases were reported in detail.

The Effect upon Metabolism of Induced Sinuous Impulses.—Dr. **Frederick H. Morse**, Boston, said the body was a storehouse of potential energy. Every part of the body had a normal rate of vibratory activity, the respiration 18 a minute, the peristalsis of the bowel 14 to 18, of the colon 6 to 8, while the ordinary rate was 80 a minute. In treating a part the author advised synchronizing the normal action of the body cells of that part. The value of stimulation of spinal nerve centres was emphasized of late in many forms of treatment. We should combine stimulation of nervous tone with exercise of a part at its normal rate. Much systemic disturbance arose from stasis in the colon and weakness of the abdominal muscles—constipation. The treatment recommended as most efficacious in this condition was by a large electrode along the spine and a smaller one on the abdomen over the colon, with the sine wave regulated to the normal rate of contraction of the part.

The War Time Uses of Electricity.—Dr. **Frank B. Granger**, Boston, said the war had served to demonstrate anew the value of physical methods of treatment for the relief of pain, the stimulation of certain types of indolent wounds, the removal of infections, the breaking down of ankylosed tissues, the restoration of atrophied muscles, the hastening of regeneration in degenerated nerves, and the improvement and cure of many functional nerve conditions. He divided the war time uses of physical measures into two heads: (1) The immediate and early convalescent stages; (2) The later or more or less chronic stage, or reconstructive and educational. In the first class relief of pain by radiant light and heat and in some instances by ionization. The condition known as trench feet was best treated by the galvanic current uninterrupted. Indolent wounds would often yield to ultra-violet radiations. Aviators after an exhausting flight were often invigorated by the high frequency in the form of auto-condensation or vacuum electrodes over the entire body. Sprains and contusions were treated by radiant heat or diathermy. After the patient had been discharged from the base hospital and sent to another hospital or a convalescent home, a greater variety of modalities and a wider range of treatment might be employed. Stiffened and ankylosed joints might be treated by chlorine ionizations. Neuritis and peripheral nerve paralyses should be treated according to the indication. Indolent ulcers were treated with zinc ionization and then ultra-violet radiations. Adherent scars would often yield to chlorine ionization followed by massage. So-called rheumatism, generally a myositis, was best treated by sodium salicylate ionization. In nerve exhaustion high frequency, static electricity and general galvanization or sinusoidalization were of extreme benefit. The returned soldier should be educated to earn a livelihood.

The Rational Management of Various Types of Neuritis.—This paper was contributed by Dr. W. L. Clark and Dr. H. Smidt, Philadelphia. In the acute form the authors laid great stress on rest, with counter-irritation and heat, by hot water, the lamp or diathermy. The diet should be looked after, and the bowels kept open. Everything that caused contraction should be avoided. In the subacute variety more energetic measures should be used to remove the infiltration. In this stage the lamp might be used plus galvanism, the high frequency vacuum tube, the brush discharge, the high frequency effleuve, the faradic or diathermy. If the wave current is used it should be very mild at first. In chronic neuritis, in addition to the foregoing hyperæmia should be produced by the static wave and the static spark. The faradic sinusoidal was good. Also hydrotherapy, the electric cabinet and baking. General tonic and reconstructive treatment should be used.

The Static Wave Current as an Aid in the Treatment of Diabetes.—Dr. William A. White, New York, read this paper. He said that in diabetes there was a diminished activity of the pancreatic parenchyma, probably due to acute or chronic congestion with some infiltration. The liver was in a state of passive congestion to a greater or less degree. The general nutrition and metabolism were gravely interfered with in diabetes. The static wave current exerted a marked and favourable effect on tissue metabolism throughout the economy, and by the passage of the current through the tissues of the insulated patient functional activity was increased, associated with restoration of the nutritive and secretory processes.

A New Test for Incipient Cancer of the Breast.—Dr. G. Betton Massey, of Philadelphia, described this test, discovered by himself, which consisted in the application of the high tension faradic current daily for not less than two or more than six weeks. A considerable experience had shown him that this would remove the usual benign causes for the tenderness and swelling. If the tumour persisted after this test it was either a carcinoma, a cystoma or a fibroma.

The Static Machine in Humid Weather.—Dr. Frederic de Kraft, New York, read this paper. After reference to certain essential details in the construction of static machines, the author said that the best material for use in the interior of the machine to absorb both moisture and nitrous oxide is unslacked rock lime, a half barrel to a machine, placed loosely in boxes well covered with cloth. Fresh lime is required about every six months. The gummy substance deposited on and in the case as a result of the action of ionized air and nitrous oxide is best removed by wiping with a cloth wet with kerosene.

Dr. **John Torbett**, of Marlin, Texas, read a paper entitled "Some Observations on Blood Pressure."

Dr. **A. L. Gordon**, of Burlington, N.J., read a paper on "Hypertension, its Early Recognition and Treatment."

Dr. **A. E. Hirsh**, of Philadelphia, read a paper entitled "Where Neuritis is proved a Wrong Diagnosis"

Report of the Committee on Standardization of Therapeutic Measures: The Cancer Problem.—The Committee's Report called attention to the attitude of the Cancer Commission, which assumes that all tumours of the female breast are significant of malignancy and should be removed when discovered. The Committee took exception to this attitude, since many of these tumours are easily removed by physical methods of treatment, and that in all cases the X-ray should precede operation and should also immediately follow the operation—an all-important method which the Cancer Commission has always failed to observe. Attention was called to the fact that the Halstead operation, by removing the normal lymphatic glands in the axilla and beneath the pectoral muscle, opened the way to the mediastinum which was otherwise protected. Radium in the treatment of cancer is far less effective than the X-ray, and useful only as a matter of convenience in exceptional cases. While the X-ray is not a specific in the treatment of cancer, it inhibits the growth in all cases and some serious forms of malignancy yield to that treatment. In epithelioma and giant celled sarcoma it may be considered practically a specific. Success from the use of the X-ray in the treatment of malignancy depends very largely upon the skill and technique of the operator. No rule as to its efficiency can be placed upon its indiscriminate, or unscientific employment. It is probable that under a more skilful technique it may be successful in most cases of malignancy, lengthening life in all cases by arresting the progress of growth. Probably no form of treatment requires greater skill and familiarity in the matter of dosage and methods of application than the X-ray. The Committee would disparage the massive dose method, as there is too great an element of danger from this method even in skilled hands. Attention is called to the fact that the important glands of the body, the liver, kidneys, adrenals, thyroids, and other secreting glands should so far as possible be protected during X-ray administrations. Protecting screens are for this purpose a necessity. The use of *filters* for eliminating the rays which produce dermatitis have made it possible to obtain far better results in the treatment of deeply located malignant growths than formerly. For measurement of X-ray dosage the pastilles were disparaged because of the unreliability, and the regulation of dosage by controlling the voltage, amperage, distance, and time of exposure, which is more scientific, is to be preferred to the unreliable measurement with pastilles. The Committee also commends the employment of electro-surgical procedures in selected cases by constant current ionization, desiccation, and thermal coagulation methods.

Report of the Committee on Mechanical Vibration Therapy, Exercise Therapy, and Apparatus.—Dr. **Mary L. H. Arnold Snow**, New York, said that as the interest of the present war demanded that the medical profession employ every available agent for amelioration, cure or reconstruction, the Committee wished to call attention to the indications for the use of mechanical vibration. These indications were: as a means of diagnosis, to elicit pain, to restore tone and regulate the rhythm of the heart in high blood pressure, as a tissue exercise in the treatment of various atrophic conditions, in chronic muscular contractions, coccygodynia and sacro-iliac luxation, in nervous headache, for relieving local spinal tenderness, and for the reflex effect in asthmatic conditions. Exercise passive and active, manual and mechanical are being used in the after treatment of many conditions, as of fibrous ankylosis and arthritis, and in the after treatment of atrophies.

Dr. **Mary L. H. Arnold Snow** also read a paper on "The Treatment of Lowered Nutrition as present in Tuberculosis."

Dr. **John W. Torbett** presented the Report of the Committee on Dietetics.

NEW TECHNIQUE.

TUBE CENTERING AND PROJECTION.

Harold C. Gage,

Radiographist to the American Red Cross Hospital of Paris, Chief of the Roentgen Service, Hospital Militaire V.R. 76, Ris-Orangis and Complementary Hospitals.

Many difficulties are experienced in the reading of X-ray plates and prints at hospitals taken by different radiologists on account of the varied position of tube, plate and patient when the radiograph was taken. The difficulties are chiefly the false relation and distortion caused by oblique projection, overlapping of bones obscuring the point of interest, obscured articulations, and observations made between the anterior, posterior, and lateral positions.

This is particularly unfortunate when a soldier is coming before a Commission of Reform which needs further radiographs so that a fair judgment may be made. On this latter point the Radiographic Section of the Service de Sante here in France have met the question of ambiguous radiographs by the following suggestion: "In all histories the radiographic prints may be substituted by a tracing accompanied by technical observations by the radiographer and signed by him. The sketch is of more value, as prints are often difficult to read, particularly, as is often the case, they pass before doctors without radiographic experience."

While the latter is undoubtedly true, and the suggestion made meets the case to some extent, no small amount of difficulty is undoubtedly due to the fact that even with good radiographs the difficulty of showing in the print what is perfectly obvious in the negative is often impossible, and that in many radiographic departments, much of the photographic work is done by men with no particular training in this most difficult branch of photographic printing.

Undoubtedly the primary cause of ambiguous and unsatisfactory radiographs is due to the position of the patient, and secondly to the centering of the tube and position of the plate. The latter is under the control of the radiographic technician, and there is no reason why plate and tube should not always occupy their true position.

With regard to the first, consideration must be given to the anatomical position of the patient, which of course, in the case of some of the wounded, offers almost insurmountable difficulties in the matter of placing a limb or patient in a satisfactory position, but some effort should be made as in this case in conjunction with a badly placed tube the result can easily be an almost unreadable radiograph. If some system were adopted much time in reading would be spared, repetition of observations and the consequent exposure of the patient and waste of materials, to say nothing of the advantage of comparison with normal plates to aid elucidation of unusual and difficult cases.

In almost every case it would be possible to establish a definite point from which to centre the tube as to its normal ray. Where no indicator of the normal ray is in use and no special centering over a given point, no definite result is obtained, which is unsatisfactory from every point of view. To this end it is thought that the following suggestions will help to secure in some measure the standardisation desired, and where possible to free articulating surfaces, and secure the well placing of the part or joint, and render it possible to use the smallest plates and to pass the normal ray through any desired spot, and should it be desired or considered necessary the normal ray can be identified, whatever position the tube may occupy, and if desired its position recorded on the plate.

The difficulties referred to can of course be overcome to some extent with an under-table tube, but this has its own disadvantages. The diaphragm, too, is of some importance owing to the fact that very few under-table tubes are provided with tubular diaphragms or room to fit them, making it invariably desirable to use the overhead apparatus. I have found that the simple appliances described below offer many advantages.

PLATE TUNNEL IN CONJUNCTION WITH A MODIFIED SCREEN.

Plate Tunnel.—Reference to Illustration 1 will show (a) a simple tunnel in wood with a 3-ply top, into which slides from the side a thin wooden bar (b), carrying at its end cross wires on its under surface; the bar is marked on its upper surface to show the position in which the wire cross comes to rest. Positions to be marked are:—

The centre of the carrier,
The centre of the left half,
The centre of the right half, viz. (h and 1).

Plate Carrier.—Illustration No. 1 (C) will be seen a base of wood, carrying at both ends a small strip of wood (Fig. *f*) to keep the plate in position when the carrier is inserted; the base may be provided with reducing frames to carry smaller plates.

When desired the plate carrier may be replaced by cassette with intensifying screen, if necessary.

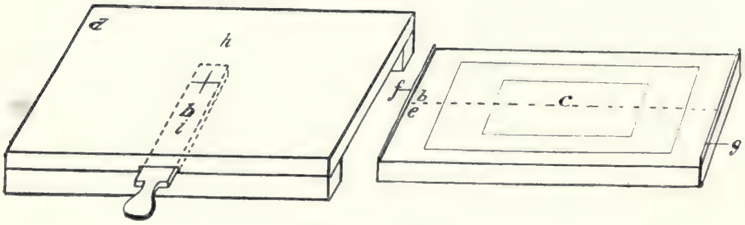

FIG 1.

Modified Screen.—Illustration 2 represents the usual wooden mounted screen to which the following modifications have been made:—

(*a*) The ordinary wooden frame with protector rising from the upper surface of the frame and projecting over the handle.

(*b*) Is a permanent soda glass cover mounted over the crystals for permanent protection of the screen.

(*c*) The lead glass protecting bound with tape, and made removable through the slot in the side, f.

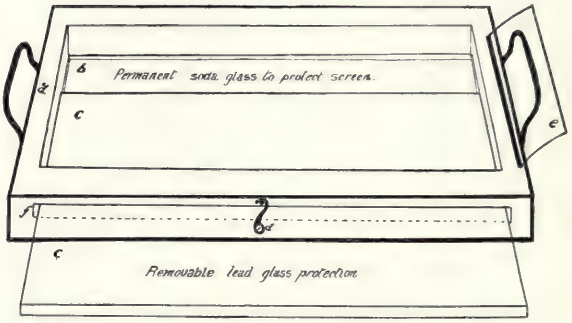
b
Permanent soda glass to protect screen.
a
c
e
f
d
c
Removable lead glass protection

FIG. 2.

(*d*) Representing a small button or catch to secure same when the screen is in ordinary use.

The Combination in Use.—Place the patient or limb on the tunnel as near in position as can be judged, with the cross wires in the centre of the tunnel, adjust the tube, remove the lead glass cover from your screen. Turn on the current to the tube and hold the screen in position under the table, crystals uppermost (Illustration 3), when the final adjustment can be made, the cross wires giving the centre of the plate. The cross wires can also when desired be made to serve in Mackenzie Davidson's localisation method to mark the position of the normal ray described later. The top of the tunnel can be grooved and inked for marking the cross on the skin. Should the cross wires not be desired they may be removed before inserting the plate.

In this manner, with an over-table tube, it is easy to get exactly the area desired on a minimum plate surface, to obtain the full view of articulating surfaces, to isolate any particular bony structure, to superimpose two lead pellets wrapped in cotton wool and placed in both ears when an absolutely lateral plate of the head is desired. A. P. pictures of the ankle, usually so unsatisfactory, can be produced with precision.

The tunnel will be found very useful in stereoscopic radiography as the plates can be changed without disturbing the position of the patient. Particularly when taking stereos of long bones on the same plate (see ARCHIVES OF RADIOLOGY, June, 1917), the only addition necessary being a strip of lead equal in size to half the plate in use, and for indication of positions the cross wires are pushed over to the central position of the half plate.

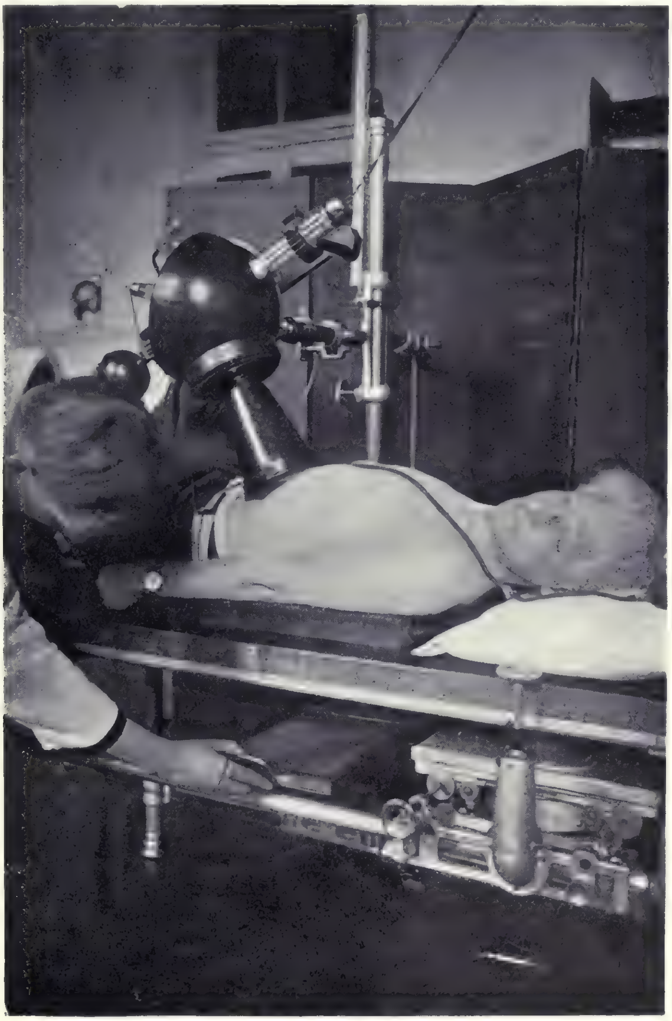

FIG. 3.

Tube Centering to Surface Anatomy.—Closely allied to the preceding is a simple device for control and identification of the normal ray. While this apparatus is designed to a French manufacture of diaphragm, it is with a little modification applicable to all.

The tube is first adjusted so that the normal ray passes exactly through the centre of the aperture of the cupule or tube box. This can be accomplished by the apparatus provided, or failing this, two metal discs may be made to fit the top aperture of the diaphragm and the second the bottom; in these two discs exactly in the centre a hole is punched. To centre the tube all that is required is to adjust the tube till on the screen held below a small circular beam is projected. This accomplished these two discs are duplicated in celluloid or stout cardboard (Illustration 4), in the small top disc a second small hole is punched (h), and in the lower a small oblong section is cut out (j). A length of silk cord is now taken (B E) and a plumb-bob (1) affixed to one end, and the cord passed up through the central perforation of the lower disc (k). In this disc the central aperture is enlarged to some 5 mm. in diameter, then through the centre of the upper disc (1) and back through the side hole (f) and slot (j), and a metal attachment added about the weight of the plumb-bob (central fig. Illustration 4). Three large dress hooks sewn to the circumference give an easy means of attachment by means of rubber bands (Illustration 5).

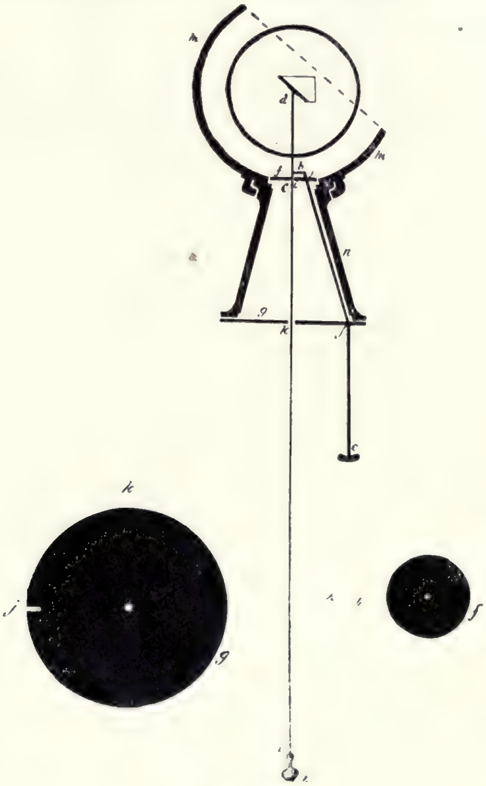

Fig. 4.

In use the position of the tube holder is adjusted until the cord of the plumb-bob hangs centrally in the aperture of the bottom disc, the plumb may then be lowered and position of the tube regulated till the plumb is over the position through which it is desired to pass the normal ray (Illustration 5). Tube is centered over head of humerus. The plumb-bob is pushed aside before exposure is made if it is desired to convey the normal ray to cross wires under the patient; it simply remains to observe in the under-table screen that the plumb-bob is projected in the centre of the cross wires.

When using the tube oblique (Illustration 6) the cord should be pulled tight and the point of the plumb placed on the position desired, and the tube stand adjusted till the cord is free and centered in the aperture of the lower disc. A small lead pellet can be affixed to the skin and radiographed on to the plate, recording permanently the position of the normal ray.

Reference to Illustration 6 will show the application of this principle to the production of antero-posterior and lateral plates. Faulty technique is largely responsible for the failure to find foreign bodies localised by such plates.

With this technique it is easily possible to standardise position and produce radiographs free from distortion, alleviating in some measure the condition referred to in the opening paragraphs.

It might seem at first that much time would be consumed in the practice of these suggestions, but if they are made a habit it will be found in the long run that time, labour, and material are saved to no small extent.

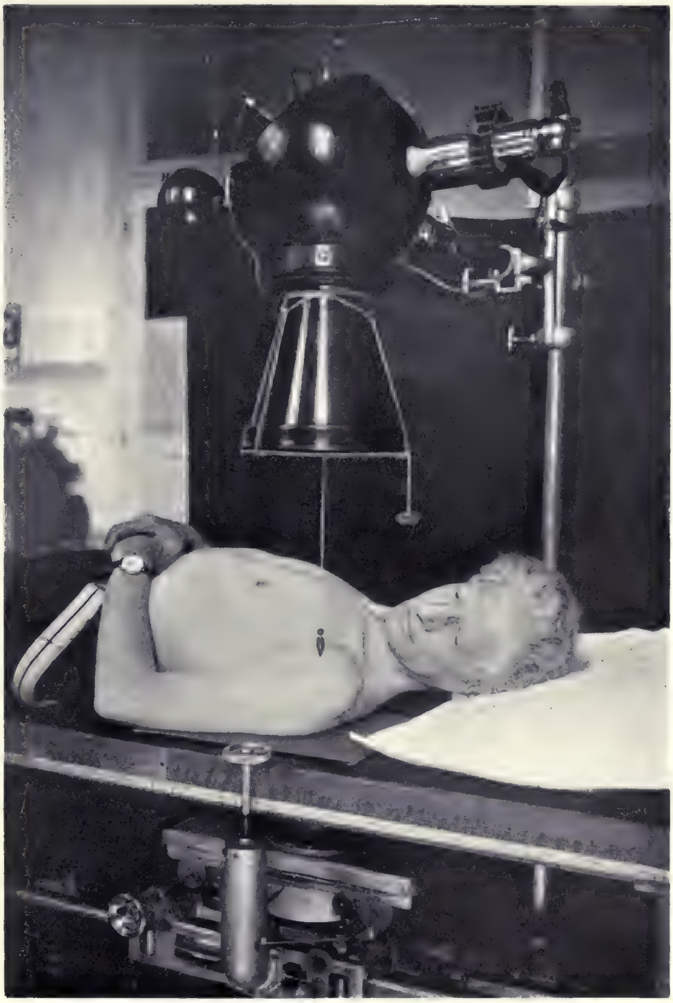

FIG. 5.

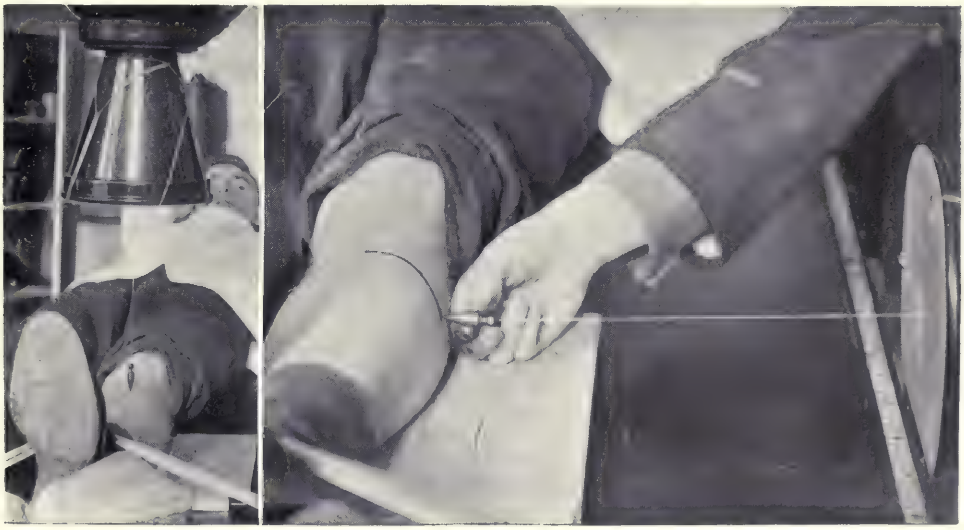

FIG. 6.

REVIEW.

Radiography and Radio-therapeutics. By Robert Knox, M.D., M.R.C.S., L.R.C.P., Consulting Radiologist to the Great Northern Hospital; Hon. Radiographer to King's College Hospital; Director of the Electrical and Radio-therapeutic Department of the Cancer Hospital; Medical Officer in Charge of the X-Ray Department of the 4th London General Hospital. (Published by A. and C. Black, London, 1918. Part II: *Radio-therapeutics.* Pp. 387-606, with fifteen full page plates and one hundred illustrations in the text.)

The extension of radiological work and the welcome with which Dr. Knox's textbook was received on its appearance as one of the Edinburgh Medical Series, in 1915, have induced him to publish the second edition in two volumes. Volume II is concerned with radiotherapy and is that now under review. Apart from a certain amount of repetition and a few typographical errors this volume merits great praise. Technical details are compressed, and yet sufficient is said in dealing with the various medical and surgical conditions usually subjected to radiation for the enquirer to learn whether X-radiation, radium (or a combination of the two), ultra-violet light or diathermy will be likely to produce the best results, and how such radiations should be applied when the choice has been made. A special section is devoted to surgical and medical conditions met with in military practice, including the influence of radiation on cheloid, on chronic suppuration and sinuses, on skin conditions, and on hyperthyroidism. Closely allied is a small section by Percival P. Cole, M.D., F.R.C.S., on the value of radiations in plastic surgery of the face and jaws. A few pages on the physics of radium, by C. E. S. Phillips, F.R.S.E., introduce that portion of the work which deals particularly with the medical uses of this substance. Naturally, much of the volume refers to the action of X rays and of radium on malignant disease, and though the author speaks guardedly, it is clear that he recognises that in the radiations we have a means of treating malignant disease which is the sole rival in the field to surgery. He refers to the variability of result in some cases, which are apparently identical and identically treated; is it not possible that the unfavourable result may have depended, at all events in part, upon injury to the leucocytes (lymphocytes) induced by heavy dosage? The leucocyte must be regarded as a protective cell, and a destructive action of the rays upon them is now well recognised.

The impression left after a careful perusal is that of a judicious combination of caution, with a tentative groping after improved results. Dr. Knox believes in a still greater future for his art than even its great present, as is shown by the following excerpt, (p. 545) ". . . In all probability the treatment of malignant disease by radiations is not nearly so efficient as it may be in the future. With advancing knowledge, improvements in apparatus and technique, and a more perfect understanding of the tissue reaction to radiations, there is every hope that in the near future a great advance in results will be attained." This view is, no doubt, correct, and the author of the volume before us has already done much to advance a fascinating, and at the same time a thoroughly utilitarian study. W. S. L-B.

NOTES AND ABSTRACTS.

RADIO-DIAGNOSIS.

Role et resultat de la radiologie dans le diagnostic de la tuberculose pulmonaire chez les soldats.—Delherm and Kindberg (*Jour. de Radiol. et d'Electrol.*, Mai - Juin, 1917, p. 572).—These authors plead for a more extended use of radiology in the detection, confirmation or otherwise of pulmonary tuberculosis in the Army, and from their own results have come to the following conclusions:—

(1) The absence of opacity, together with the absence of physical signs and bacteriological findings indicates, when one is faced with purely functional symptoms, an examination of the nose and larynx.

(2) In subjects with bacilli in the sputum, general or functional symptoms, but who do not present any physical signs (missed perhaps by the interposition of healthy tissue between the focus and the ear), the absence of an abnormal radiographic appearance allows of the diagnosis of early tuberculosis and a favourable prognosis.

(3) The presence of an opacity without physical signs draws attention to the lung.

Abnormal shadows plus physical signs are of indisputable importance. In both cases, the question most often arises between an apical pleurisy, sclerosis, old healed tuberculosis, and tuberculosis in progress; bacteriology should settle the point.

(4) In those cases which show a generalised bronchitis, radiology sometimes confirms the absence of zones of condensation, at other times detects advanced lesions and even cavities.

(5) Radiology helps to detect cases mistaken for tuberculosis, and which are sometimes so difficult to diagnose by other means, suppurating interlobar pleurisies, abscess of the lung, hydatid cysts, cancer, and syphilis.

(6) In well advanced cases, it very often shows the lesion to be more extensive than was suspected clinically, old complications which had been undetected, small pleurisies at the base, adhesions, pneumothorax, and hydropneumothorax.

(7) Radiology is also useful by the indications it can give as to the line of treatment, and it is indispensable when an artificial pneumothorax has to be made.

R. W. A. S.

Le radiodiagnostic du rein en fer a cheval.—N. Voorhoeve (*Jour. de Radiol. et d'Electrol.*, Juillet-Août, 1917, p. 599).—The author gives the following findings he has observed in the condition of horse-shoe kidney, and which are to be accounted for by this abnormality.

(1) The vertical position of the two kidneys, their internal borders being parallel to the vertebral column.

(2) The median position of the two kidneys, the distance between their internal borders and the vertebral column being unusually small.

(3) Ptosis, equally present on both sides.

(4) Loss of movement in the medio-lateral direction, though movement in the axial direction may be preserved.

(5) An apparent displacement of the inferior borders of the kidneys with relation to the vertebral column. The kidneys have turned round a ventro-dorsal axis, so that their inferior poles are displaced towards the median line, where they are firmly fixed, and cannot change their relation to each other.

(6) The possible demonstration of the connecting isthmus. R. W. A. S.

RADIOTHERAPY.

Contribution to the Study of the X-Ray Treatment of the Adenopathies.—F. Navas Sanjuan (*Revista Españolo de Electrologia y Radiologia Medicas*, Sept., 1917).—The author gives details of the case of a man of 41, who came under his treatment. The case was diagnosed, in consultation, as undoubtedly one of early Hodgkins' disease with rapid spreading to new lymphatic areas. Two applications of rays of 6 Benoists, with 1 mm. aluminium filter, were given, with eight days interval. The irradiation at the level of the lesion was approximately equivalent to Tint 2, on the Bordier scale. After the second treatment the mass increased in volume, broke down spontaneously, and for eleven days discharged a sero-sanguineous fluid. Healing then took place, with an almost imperceptible scar. Subsequent applications were less intense, and by the end of the sixth session, which formed the course of treatment and lasted fifty-one days, the subsidiary swellings had decreased and were hardly perceptible, and the neck measurement was much reduced. The patient was well a month later, and there was no sign of recurrence. He was still under observation.

The author considers that X rays constitute the most satisfactory treatment of the adenopathies, being painless, not weakening, and leaving no disfiguring scars. N. B.

ELECTROTHERAPY.

Electrotherapy in Treatment of a Case of Cataract and Results.—Moses G. Campbell (*American Journal of Electrotherapeutics and Radiology*, Aug., 1917).—Faced with the problem of a lady of 73, who was developing cataract in both eyes, the author searched the literature for some guidance as to possibilities of giving treatment, rather than waiting for ripening of the lenses and surgical operation. At last he found in "Electricity in Diseases of the Eye, Ear, Nose and Throat," by W. Franklin Coleman, reports of successful use of high frequency effleuves, radiant heat, mechanical vibration, X rays, and galvanism, of which the last named was the most promising.

With the consent of the oculist, who was by no means hopeful of results, he instituted treatment on 11th Feb., 1916. At first radiant heat was tried, but it caused pain and was omitted after one month. Autocondensation was used throughout, with the idea of improving the general nutrition after a severe cold and bronchitis, and also to relieve her general rheumatoid condition.

The local treatment was the negative pole of the direct current applied by a specially made electrode over both eyes, while the positive was over the back of the neck. Treatments were for twenty minutes daily, from 3-10 ma. being given.

By the end of March there was marked improvement in clearness of vision, and by June the oculist reported improvement beyond his expectations, and the cataract was not so dense. He was able with glasses to make vision practically normal, and the patient could see objects clearly.

The last report was dated a year after the treatment, and at that time the lenses were clear. The author discusses the various theories of the formation of cataract, and concludes that a vicious circulation in the eye, whatever the cause may be, is responsible. It is, therefore, reasonable to suppose that the galvanic current applied locally will favourably influence any such faulty nutritive condition.

In order to be successful without operation, treatment must begin early, and the general health must be looked to and all morbid tendencies corrected.

N. B.

NEW APPARATUS.

A Screen for Radioscopy. — Charlier (*Archives d'Electricité Médicale*, October, 1917, p. 461). — The radiologist is often compelled to hold the screen in his hand while making thorough and prolonged examinations. The ordinary screen is unsatisfactory for this purpose and gloves give insufficient protection to the hand. To meet this difficulty the author has devised a new type of screen, which is made for him by Gaiffe.

The size is 13 by 18 cm., which is uncumbersome, and light and practical for most purposes. The active surface is covered over with a thick anti-X glass; the other side is lined with aluminium of ·5 mm. thickness. This cuts out the soft rays, preserves the screen from shocks, from soiling by blood, discharges, etc.; it is movable and permits of cleaning, or, if need be, of sterilization.

The frame is of aluminium and is fitted at one end with a bar coming off at right angles

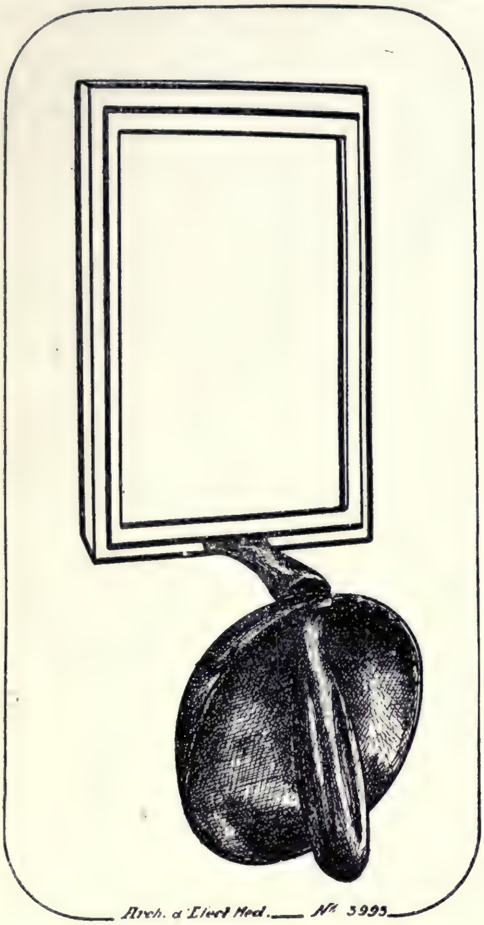

Fig. 1. — Explorateur radioscopique du Dr A. Charlier.

to the plane of the screen. This bar is bent again and forms a handle, round which is a cup-shaped shield of nickelled copper. The position and setting of the handle bring the operator's hand out of the line of the central rays; the shield forms a complete protection from any others. N. B.

The Barnet X-Ray Plate.—Messrs. Elliott and Sons, Ltd., of Barnet, have issued a pamphlet setting forth the qualities of the Barnet X-ray Plate. The production deals with the plate and its manipulation, and is illustrated by a number of good reproductions of subjects taken upon the plate.

Full instructions are given for exposure, development, reduction, and intensification of negatives.

The booklet should prove useful to those radiologists who use the plate and is sent post free to anyone interested, on application.

The "Sunic" Plate.—Messrs. Watson and Sons (Electro-Medical), Ltd., have issued a useful description of the "Sunic" Plate. The special points in favour of this plate are enumerated and a number of useful, practical hints on development and after-treatment are given. These are particularly clear in regard to the handling of the plate, the use of an intensifier screen, and the fixing of the plate after development. A useful exposure table is also given.

PUBLICATIONS RECEIVED.

Books.

Radiography and Radio-therapeutics. Part II. *Radio-therapeutics.* By Robert Knox, M.D. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.). London: A. and C. Black, Ltd., 1918.

A Text-Book of Radiology (X Rays). By Edward Reginald Morton, M.D., C.M. (Trin. Tor.), F.R.C.S. (Ed.), etc. London: Henry Kimpton, 1918.

Journals.

American Journal of Roentgenology, Feb., Mar., 1918.

Archives de Electricité Médicale et de Physiothérapie, Mar., 1918.

Archives de Médecine et de Pharmacie Militaires, Jan.-Feb., 1918.

Boston Medical and Surgical Journal, Mar. 14th, 21st, 28th, 1918.

Bulletin of the Johns Hopkins Hospital, Mar., 1918.

Journals—*continued.*

Cleveland Medical Journal, Feb., 1918.

Gaceta Médica Catalana, Mar. 31st, 1918.

Good Health, Mar. 1918.

Hospitalstidende, Mar. 20th, 27th, April 3rd, 10th, 1918.

Interstate Medical Journal, Feb., 1918.

La Radiologia Medica, Mar.-April, 1918.

Medical Bulletin, Mar., 1918.

Medical Journal of Australia, Jan. 5th, 12th, 19th, 26th, Feb. 2nd, 1918.

New York Medical Journal, Mar. 9th, 16th, 23rd, 30th, April 6th, 1918.

New York State Journal of Medicine, Mar., 1918.

Norsk Magazin for Lægevidenskaben, April, 1918.

Revista Médica de Málaga, Mar., 1918.

Southern Medical Journal, Mar., 1918.

Ugeskrift for Læger, Mar. 21st, 28th, April 4th, 11th, 1918.

NOTICES.

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LIST OF RADIOLOGISTS AND ELECTRO-THERAPEUTISTS PRACTISING IN THE BRITISH EMPIRE AND AMERICA.

The Editors, in publishing the following List of Radiologists, regret that it is very incomplete, as the replies to their request fell far short of their expectations. However, it has been decided to publish the List, in the hope that it may form a foundation for a more complete one in the future.

BRITISH ISLES.

ASHTON-UNDER-LYNE	**MORISON, J. M. Woodburn,** "Nowellthorpe."—M.B., C.M. *Past Appointment*—Radiographer, Liverpool Merchants' Hospital, France. *Present Appointment*—Hon. Radiographer, District Infirmary, Ashton-under-Lyne. Author of *Gas in the Tissues*, "Archives of Radiology and Electrotherapy," Dec., 1915.
BARROW-IN-FURNESS	**ALEXANDER, George,** 105, Abbey Road.—M.B., Ch.B. (Glas.), F.R.C.S., (Edin.). *Present Appointment*—Honorary Surgeon, with charge of Electrical Department, North Lonsdale Hospital.
BATH	**MACKAY, James Forbes,** 16, Pierrepont Street.—M.D. (Edin.), M.B., Ch.B., D.P.H. *Past Appointments*—Hon. Assist. Anæsthetist, Royal United Hospital, Bath ; Resident Medical Officer, Royal Mineral Water Hospital, Bath; House Physician, County Hospital, Newport, Monmouthshire. *Present Appointments*—Hon. Medical Superintendent, X-Ray and Electrical Department, Royal Mineral Water Hospital, Bath ; Radiographer, British Red Cross Hospital, Netley, with the rank of Captain in the R.A.M.C.
BIRMINGHAM	**BLACK, Harold,** 51, Newhall Street.—M.D. (Belfast), M.R.C.P. (Lond.). *Present Appointments*—Radiographer, Second Birmingham War Hospital ; Radiographer, Queen's Hospital, Birmingham ; Birmingham and Midland Hospital for Sick Children ; Walsall and District Hospital.
	EMRYS-JONES, Franklin, 141a, Great Charles Street.—B.A. (Cantab), L.M.S.S.A. (Lond.). *Past Appointments.*—Radiographer, Queen's Hospital, Birmingham ; Radiographer, Coventry Polyclinic for Ringworm ; Resident Pathologist, General Hospital, Birmingham. *Present Appointments*—Radiographer, General Hospital, Birmingham ; Radiographer, First Birmingham War Hospital ; Radiographer, Guest Hospital, Dudley ; Radiographer, Dental Hospital, Birmingham ; Radiographer, Eye Hospital, Birmingham. Author of *Use and Abuse of Radium, Diagnostic Value of Bismuth Bolus*, "Practitioner."

BOGNOR	**REY, Jules Frederick**, 9, Park Road.—M.R.C.S. (Eng.), L.R.C.P. (Lond.), etc. *Past Appointment*—House Surgeon, Royal Boscombe and West Hants Hospital, Bournemouth, now Royal Bournemouth and West Hants Hospital. Author of (1) *Soamin Treatment of Cerebro-Spinal Meningitis*, "B.M.J.," 1915; (2) *The Value of Blood Examination in Acute Disease*, "Practitioner," Nov., 1915; (3) *An Extreme Case of "Dropped" Transverse Colon in a Young Girl*, "Practitioner," July, 1916.
BOURNEMOUTH	**FOWLER, Frank**, 29, Poole Road.—M.D. *Present Appointment*—Hon. M.O. i/c Electrical Department, Royal Victoria and West Hants Hospital, Bournemouth.
BOURNEMOUTH, W.	**RUTTER, George Herbert**, "Roxbury House," 22, Poole Road.—M.B., C.M. (Edin.), L.R.C.P., L.R.C.S. (Edin.), L.S.A. (London). *Past Appointments*—Demonstrator, University of Dublin and St. Bartholomew's Hospital, London; Surgeon, Smallwood Hospital, Redditch.
BRADFORD	**MITCHELL, William**, "Woodville House"; Chambers, 103, Manningham Lane.—M.B. and C.M. (Edin.), 1894. *Present Appointments*—Hon. Physician in charge, Electrical Department, Bradford Royal Infirmary; Radiologist, Royal Eye and Ear Hospital, Bradford; Radiologist, Bradford War Hospital. Author of various papers.
BRIGHTON	**BAILEY, Charles Frederic**, 125, Marine Parade.—M.D. (Lond.), M.R.C.P., D.P.H., Major R.A.M.C. (T.F.), 2nd East General Hospital. *Present Appointment*—Assistant Physician and Electro-Therapeutist, Royal Sussex County Hospital. Author of articles on Stereoscopic Radiography, Fractures, Foreign Body Localisation, Ionisation, and High Frequency.
	GRIGGS, William Alfred, 60, Montpelier Road.—L.R.C.P. (Lond.), M.R.C.S. (Eng.).
BURNLEY	**CRUMP, Thomas Greenwood**, "Brown Hill."—B.A., M.B., B.C. (Cantab), M.R.C.S., L.R.C.P. *Present Appointments*—Hon. Physician and Hon. Radiologist, Victoria Hospital, Burnley; Civil Surgeon in charge of the X-Ray Department, Queen Mary Military Hospital, Whalley.
CAERLEON (Mon.)	**McGINN, John**, Tattysallagh.—F.R.C.S. (Ireland). Author of *Pathogeny of Cancer* (Translation), "Practitioner," 1913.
CAMBRIDGE	**SCALES, F. Shillington**, "Redcourt," Adam's Road.—M.A., M.D., B.C. (Cantab). *Present Appointments*—Assistant Physician in charge of Electrical Department, Addenbrooke's Hospital, Cambridge; Lecturer in Microscopy, Westminster Hospital. Author of *Elementary Microscopy*, *Practical Microscopy*, *The Electrocardiogram as an Aid to Diagnosis*, many papers in scientific journals.

CHATHAM

SMITH-SHAND, Alexander Kenneth, Royal Naval Hospital.—M.B., Ch.B. (Edin.) *Past Appointment*—Radiographer and Electrotherapist, Royal Naval Hospital, Haslar. *Present Appointment*—Radiographer and Electrotherapist, Royal Naval Hospital, Chatham.

CHELTENHAM

MEYRICK-JONES, Hugh Meyrick, "Ashfield" Bayshill.—M.D., B.S., M.R.C.S., L.R.C.P. *Past Appointments*—Hon. Radiographer to Eye, Ear, and Throat Hospital, Cheltenham; The General Hospital, Cheltenham. *Present Appointment*—Radiographer, No. 30, General Hospital, B.E.F.

COLCHESTER

HOGG, William John, General Hospital.—M.R.C.S. (Eng.), L.R.C.P.(Lond.). *Past Appointment*—Assistant Physician X-Ray and Electrotherapeutic Department, Middlesex Hospital, London, W. 1. *Present Appointment*—Officer in charge, X-Ray and Electrotherapeutic Department, General Hospital, Colchester.

CORK

SUNNER, Richard, Medical Hall.—X-Ray Specialist and Pharmacist. *Present Appointment*—X-Ray Specialist to Medical Profession, County and City of Cork.

DERBY

BARWISE, Sidney, County Offices.—M.D. (Lond.), B.Sc. (B'ham). *Present Appointment*—School Medical Officer, Derbyshire. Author of *Annual Reports of S.M.O., Derbyshire; X-Ray Treatment of Ringworm and Alopecia.*

DUBLIN

HARDMAN, Townley Garratt, 32, Lower Baggot Street.—M.D., B.Ch., B.A.O. (Dublin University); L.M., Rotunda Hospital. *Past Appointment*—House Surgeon, Adelaide Hospital, Dublin. *Present Appointments*—Radiologist, Mercers' Hospital, Dublin; Advising Physician, Convalescent Home, Stillorgan, co. Dublin. *Temporary Appointments*—Radiologist, Adelaide Hospital, Dublin; Radiologist, Richmond Hospital, Dublin. (In absence of regular men who have gone to France).

HARVEY, William Geoffrey, 62, Lower Baggot Street.—M.D., F.R.C.P.I., Temp. R.A.M.C. Major. *Past Appointment*—Radiographer, Mercer's Hospital, Dublin. *Present Appointments*—Assistant Physician and Radiographer, Adelaide Hospital, Dublin; Physician and Radiographer, Irish Counties War Hospital; University Demonstrator X-Ray Work, Dublin University. Author of *On the Pathological Effects of Roentgen Rays on Animal Tissues*, "Journal of Pathol. and Bacteriol.," vol. xii., 1908; *The Roentgen Rays in Medical Diagnosis*, "Dublin Journal Med. Science," Jan., 1913.

HAYES, Maurice R. J., 35, Upper Fitzwilliam Street.—F.R.C.S.I. *Past Appointment*—Examiner in Chemistry, Royal College of Surgeons, Ireland. *Present Appointments*—Radiologist, Mater Misericordiæ Hospital, Dublin; Hon. Radiologist, Dublin Castle Red Cross Hospital and Red Cross Hospital for Wounded Officers; Assistant Professor Materia Medica,

DUBLIN

University College, Dublin. Author of *Radiotherapy in Spleno-Medullary Leukæmia; X-Ray Diagnosis of Aneurysm of Thoracic Aorta; X-Ray Diagnosis of Urinary Calculi; X-Ray Diagnosis of Abnormalities of Intestinal Tract.*

STEVENSON, Walter C., 60, Lower Baggot Street, Dublin.—M.D., B.Ch., D.P.H., B.A. *Present Appointments.*—Surgeon and X-Ray Officer, Dr. Steven's Hospital, Dublin; Surgeon Orthopædic Hospital, Dublin. Author of *Chapter on Radiotherapy in Gynæcology, in Jellett's "Practice of Gynæcology"*; *The Theory and Technique of Treatment by Radium Emanation Needles*, "British Medical Journal," March 20th, 1915; *An Economical Method of Using Radium for Therapeutic Purposes*, "Medical Press and Circular," March 14th, 1914; *Preliminary Report of a New and Economical Method of Radiumtherapy by Means of Emanation Needles*, "British Medical Journal," July 4th, 1914; *A Method of Recording Radium Dosage*, "Archives of Radiol.," Jan. 1916; *A Convenient Radium Emanation Table for Clinical Work*, "Archives of Radiol.," March, 1916.

DUNDEE

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EASTBOURNE

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EXETER

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FOLKESTONE

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GLASGOW

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GLASGOW **RIDDELL**, James Robertson, 1, Royal Crescent, W.—F.R.F.P.S. *Past Appointments*—Hon. Surgeon and Physician, Royal Infirmary; Dispensing Surgeon, Victoria Infirmary; Dispensing Surgeon, Royal Samaritan Hospital. *Present Appointments*—Medical Electrician, Royal Infirmary, Glasgow; Radiologist, Royal Cancer Hospital; Radiologist, 4th Scottish General Hospital, Capt. R.A.M.C.T., &c. Author of *Radium in the Treatment of Malignant Disease*, "B. M. J.," May 9th, 1914; *X-Rays in Treatment*, "B. M. J.," May, 1911; *Treatment of Ringworm*, "B. M. J.," February, 1912.

SLOAN, Samuel, 5, Somerset Place, W. 1.—M.D., F.R.F.P.S.G. *Past Appointments.*—President Electrotherapeutic Sect. Roy. Soc. of Medicine; President Sect. of Radiology and Electrotherapeutics, Brit. Med. Assoc., 1914. *Present Appointments.*—Consulting Physician, Glasgow Maternity Hospital; Examiner, Glasgow University; Consulting Physician, Glasgow Women's Hospital. Author of *Electrotherapy in Gynæcology* and various papers on *Electrotherapy*, etc.

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LEICESTER

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LETCHWORTH

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LIVERPOOL

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HOLLAND, Charles Thurstan, 43, Rodney Street.—M.R.C.S. (Eng.), L.R.C.P. (Lond.). *Past Appointment* — Hon. Med. Off., X-Ray Department, Royal Southern Hospital, Liverpool. *Present Appointments*—Hon. Med. Off. Electrical Dept., Liverpool Royal Inf.; Hon. Med. Off., X-Ray Dept., Liverpool Children's Inf.; Hon. Med. Off., Baschurch Hospital. Author of various articles in journals; Presidential Addresses to Röntgen Soc. of London, 1904, 1916.

LONDON

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LONDON

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BUTCHER, William Deane, "Holyrood," Cleveland Road, Ealing, W. 13.—M.R.C.S. *Past Appointments*—Radiologist, London Skin Hospital; President of Electrotherapeutical Section, R.S.M.; President of Röntgen Society. *Present Appointment*—Consulting Surgeon, London Skin Hospital; retired. Editor of "Archives of the Roentgen Ray," 1906-1914; Translator of Belot's "Radiotherapy"; Guilleminot's "Medical Electricity"; Leduc's "Mechanism of Life."

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LONDON

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GOULDESBROUGH, Claude, 56, Welbeck Street, W. 1.—M.A., M.B., B.A. (Oxon), M.R.C.S., L.R.C.P. *Past Appointments*—Clinical Assistant, St. Thomas's Hospital; H.P., Addenbrooke's Hospital, Cambridge; Senior Clinical Assistant, X-Ray Department, St. Thomas's Hospital; Consulting Radiologist, B.E.F., France. *Present Appointments*—Assistant Superintendent, Electrical and X-Ray Department, St. Thomas's Hospital; Acting Radiologist, Royal West. Ophthalmic Hospital; Military Radiographer, No. 5, General Hospital, London. Author of *X-Ray Appearances in Hypertrophic Pulmonary Osteo-arthropathy; Curious Case of Hip and Spine Disease*, "Archives of Roentgen Ray"; *Some Notes on the Military Radiography during first Nine Months of the War*, "R.A.M.C. Journal."

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HAMPSON, William, 8, West Chapel Street, Mayfair, W. 1.—M.A.(Oxon.), L.M.S.S.A. (Lond.). *Past Appointments*—Med. Officer in charge, X-Ray and Electrical Department, Queen's Hospital for Children; Medical Officer, X-Ray and Electrical Department, St. John's Hospital for Diseases of the Skin. Author of *Radium Explained; Paradoxes of Nature and Science; Control of the Heart-beat by the Contraction of Muscles Electrically Stimulated; On the Simple and Direct Localisation of Bullets, etc., by the Screen.*

LONDON

HERNAMAN-JOHNSON, Francis, 33, Cavendish Square, W. 1.—M.D., Ch.B. (Aberd.). *Present Appointment*—Consulting Radiologist and Electrotherapist to Military Hospitals, Aldershot Command. Author of *The Localization of Bullets and Shell Fragments.*

HUMPHRIS, Francis Howard, 8, West Chapel Street, Mayfair, W. 1.—M.D., F.R.C.P. *Past Appointments*—President, American Electrotherapeutics Association; Consulting X-Ray Physician to the Force in Egypt; Major, R.A.M.C. *Present Appointment*—Officer in charge of X-Ray and Electrotherapeutic Department, 3rd London General Hospital. Author of *Electrotherapeutics for Practitioners.*

JORDAN, Alfred Charles, 13, Upper Wimpole Street, W. 1.—M.D. (Camb.), M.R.C.P. *Past Appointments*—Medical Radiographer, Guy's Hospital; Metropolitan Hospital; Queen's Hospital for Children. *Present Appointments*—Hon. Radiologist, Hospital for Officers, Fishmonger's Hall, and Queen Alexandra's, Highgate; also to Royal Hospital for Diseases of the Chest. Author of numerous papers on Chronic Intestinal Stasis, Peribronchial Phthisis, and other X-Ray subjects.

KINGSBURY, William Neave, 70, Wimpole Street, W. 1.—M.R.C.S., L.R.C.P. *Present Appointments*—Assistant to Surgeon in Charge, Electrotherapeutic Department, Middlesex Hospital; Radiologist, Evelina Hospital; Hon. Radiologist, Putney General Hospital. Author of *Treatment of Exophthalmic Goitre by X Rays,* "Proceedings R.S. Med."

KNOX, Robert, 38, Harley Street, London, W. 1.—M.D. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.).—*Past Appointment*—Hon. Medical Officer in Charge of Electrical Department, Great Northern Hospital, N. *Present Appointments*—Consulting Radiologist to Great Northern Central Hospital; Hon. Radiographer, King's College Hospital, London; Director, Electrical and Radiotherapeutic Department, Cancer Hospital, London. Author of *Radiography, X-Ray Therapeutics and Radium Theraphy.*

LYSTER, Cecil R. C., 70, Wimpole Street, W. 1.—M.R.C.S. *Past Appointments*—Medical Superintendent, Bolingbroke Hospital; Hon. Physician, Charing Cross Hospital. *Present Appointments*—Medical Officer in Charge, Electrical Department, Middlesex Hospital; Medical Officer in Charge, Electrical Department, Queen Alexandra's Hospital, Millbank. Author of articles in "Archives Middlesex Hospital."

MACGREGOR, Alastair, 14, Welbeck Street, W. 1.—M.D. (Edin.), and C.M. *Past Appointments*—Physician, Electrical Department, British Red Cross Hospital, Netley; Clinical Assistant, Electrical and X-Ray Departments, West London Hospital. *Present Appointments*—Chief Assistant, Electrical Department, St. Bartholomew's Hospital, E.C.; Assistant Physician, Massage and Electrotherapeutical Department, King

George's Hospital. Author of *Two Cases of Electrical Burn Successfully Treated by Ionisation*, "Archives of Radiology and Electrotherapy," 1915; *The Light from the Simpson Arc Lamp* (*the so-called "Simpson Light"*), *its Nature and Therapeutic Properties*, Ibid, 1916; *Remarks on the Simpson Light*, "West London Medical Journal," 1916.

MORROW, David, "Woodhurst," Old Park Road, Palmer's Green, N., and Middlesex Hospital, W. 1.—M.R.C.S. (Eng.), L.R.C.P. (Lond.), L.S.A. (Lond.) *Past Appointments*—Medical Officer in Charge, Avonmouth Hospital, Bristol; Assistant Medical Officer, Altrincham Hospital, Cheshire; Officer in Charge X-Ray Department, Netley Hospital; and No. 19 General Hospital, Alexandria. *Present Appointment*—Assistant Medical Officer, Electrotherapeutic Department, Middlesex Hospital, W.

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SALMOND, Robert W. A., 9, de Crespigny Park, Denmark Hill, S.E. 5.—M.D., Ch.M. *Past Appointment*—Radiographer, Queen's Hospital for Children, Hackney, E. *Present Appointments*—Assistant Radiographer, King's College Hospital; Radiographer, Central London Ophthalmic Hospital; Surgeon in charge, X-Ray Department, St. Mary's Hospital, Plaistow, E. Author of *Experiments in X-Ray Filtration*, "Proc. Roy. Soc. of Med.," 1914; *System of Topography for Use in Radiography of the Head* (with Dr. Knox), "Archives of the Roentgen Ray," 1915; *Tuberculosis of the Bones and Joints*, "Archives of Radiology and Electrotherapy," 1916.

LONDON

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SCOTT, Sebastian Gilbert, 6, Bentinck Street, Cavendish Square, W. 1.—M.R.C.S., L.R.C.P. (Lond.). *Past Appointments*—Clinical Assistant, Radiographic and Electrical Department, King's College Hospital; Radiologist to National Hospital for Diseases of Heart; Radiologist, Poplar Hospital for Accidents. *Present Appointment*—Medical Radiologist to the London Hospital. Author of *Case of X-Ray Dermatitis with Fatal Termination*, "Archives of Roentgen Ray," 1911; *Cervical Ribs seen Radiographically*, "B. M. J.," 1912; *Radiographic Appearances of Malignant Bone Diseases*, XVII International Congress of Medicine, 1913.

STONEY, Florence A., 29, Nottingham Place, W. 1.—M.D., B.S. (Lond.). *Past Appointments*—Head of the X-Ray Department, Royal Free Hospital, and New Hospital for Women. *Present Appointment*—Head of the X-Ray Department, Fulham Military Hospital, S.W. Author of *Results of Treating Exophthalmic Goitre with X-Rays*, "B. M. J.," August, 1912; *On the Connection between Soldier's Heart and Hyperthyroidism*, "Lancet," April 8, 1916.

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MANCHESTER

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MANCHESTER **BYTHELL, W. J. S.,** Beech Hill, Kersal, Manchester, and 40, Brazennose Street, Manchester.—B.A. (Cantab.), M.D. (Vict.). *Past Appointments*—House Physician, Manchester Royal Infirmary; Resident Medical Officer, Manchester Children's Hospital, etc. *Present Appointments*—Physician to Electrotherapeutic Department, Ancoats Hospital, Manchester; Radiologist to Manchester Children's Hospital, and Salford Royal Hospital; Captain, R.A.M.C., T.F. Author of (with Dr. Barclay) *X-Ray Diagnosis and Treatment*; *Radiography of Renal and Ureteral Calculi*, "Medical Chronicle," 1909; *Empyema in Children: a Contribution to its Bacteriology*, "Jl. Path & Bact.," 1904.

NEWCASTLE-ON-TYNE **BUNTING, Thomas Lowe,** 38, Moorside.—M.D., C.M., B.Hy., F.R.S.E. *Present Appointments*—Physician in charge of Electric Department, Sick Children's Hospital, Newcastle; Radiographer, Northumberland War Hospital. Author of *Osteoma of Phalanx* "Archives of Roentgen Ray"; *X Rays in Treatment of Ulcerative Blepharitis*, "Lancet."

MARTIN, William, "West Villa," Akenside Terrace.—M.A., M.D., M.S., Ass. I.E.E. Author of *Notes and Skiagrams*, "Archives of Roentgen Ray," 1898; *X-Ray Localisation*, Transactions of Northumberland and Durham Med. Soc., 1903; *Bicipital Tubercle of Radius and X-Ray Examination*, Proceedings of Royal Society of Medicine, 1909.

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REDHILL (Surrey) **ANSTEY-CHAVE, Thomas,** "Chilworth."—M.B. (Lond.), F.R.C.S.E., M.R.C.S. (Eng.), L.R.C.P. (Lond.). *Present Appointment*—Medical Electrician, Reigate and Redhill Hospital.

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SOUTHWOLD	**MULLOCK, Richard Wilson**, "Wymering House."—M.D., B.Ch., B.A.O. (Dublin Univ.). *Past Appointment*—Civ. Surg., S. Africa, 1901. *Present Appointments*—Medical Officer, Henham Hall Hospital for Wounded; Medical Officer, Southwold Cottage Hospital. Author of *Operation for Decompression Recovery*, "B. M. J.," 1912; *Case of Septicæmia cured by Vaccine*, "Practitioner," 1912.
STAPLE-HURST (KENT.)	**VILVANDRE, George**, "Green Court."—M.R.C.S. (Eng.), L.R.C.P. (Lond.). *Past Appointments*—House Surgeon and House Physician, Poplar Hospital for Accidents; Clinical Assistant, Chelsea Hospital for Women; some time in charge X-Ray Department, Connaught Hospital, Aldershot. *Present Appointment*—Radiologist, No. 16 General Hospital, B.E.F., Tréport, France. Author of *A Few Radiograms to illustrate the Velocity of the Rifle Bullet as the determining Factor in the Extent of an Injury*, "Archives of Radiology and Electrotherapy."
STOKE-ON-TRENT	**JOHN, A. Hilton**, 6, Brook Street.—M.B., B.S., (Lond. Univ.). *Present Appointments*—(1) Radiologist and Electrotherapist to the North Staffs Infirmary and Eye Hospital; (2) Radiologist to Longton Cottage Hospital, Stoke-on-Trent.
STRATFORD-ON-AVON	**ASHWIN, Alice M. (Miss)**, Waterloo Hill, Stratford-on-Avon. *Present Appointment*—Radiologist to the Stratford-on-Avon Hospital.
SUNDERLAND	**WATERS, James Bowden**, 39, North Bridge Street.—M.D., B.S. *Past Appointment*—Hon. Radiographer, Sunderland Royal Infirmary. *Present Appointments*—Hon. Radiologist, Monkwearmouth and Southwick Hospital; Hon. Physician, Sunderland Royal Infirmary.
TWICKEN-HAM (EAST)	**BRAMWELL, Hugh Ransom**, 37, St. Stephen's Gardens.—M.B. (Edin.), M.R.C.S. (Eng.). *Past Appointment*—Chief Clinical Assistant, X-Ray Department, West London Hospital. *Present Appointments*—Temp. Capt. R.A.M.C.; Specialist in charge of X-Ray and Electrotherapeutic Department, Southern Military Hospital, Dartford.

WOLVERHAMPTON	**CODD, John Alfred**, 7, Tettenhall Road.—M.D., B.Sc. (Lond.) *Past Appointments*—House Physician, General Infirmary, Leeds, and General Hospital, Wolverhampton. *Present Appointments*—Hon. Physician, Hon. Radiographer, and Electrotherapeutist, General Hospital, Wolverhampton, etc. Author of *Treatment of Glandular Enlargements by X-Rays*; *The Electric Series Bath*; *Treatment of Malignant Disease by X Rays*; *Interpretation of Opaque Meals*, etc.

U.S.A.

ALABAMA **Birmingham**	**EDMONSON, John Heron**, Empire Bldg. *Past Appointment*—Vice-President, American Roentgen Ray Society.
ARKANSAS **Hot Springs**	**DIEMER, Fred Carl.**
Little Rock	**ZELL, Augustus M.** Engaged in Roentgenology for eight years. *Past Appointment*—Radiography of St. Louis Iron Mountains, Southern S.Mo.P.R.R. *Present Appointment*—Roentgenologist to Fort Logan H. Root's Hospital.
CALIFORNIA **Alameda**	**LUM, William Tappan**, 1361, Park Street.
Los Angeles	**BOWMAN, William B.**, 818, Brockman Bldg.—Roentgenologist. *Present Appointments*—First Vice Pres. American Roentgen Ray Society; Consulting Roentgenologist, Children's Hospital, Los Angeles; California Hospital, Los Angeles; L. A. County Hospital; Sister's Hospital, Los Angeles.
San Diego	**KINNEY, Lyell Cary**, 415, Elm Street.—Roentgenology. *Past Appointments*—Instructor Roentgenology, University of So. California; Roentgenologist, California Hospital. *Present Appointments*—Roentgenologist, San Diego County General Hospital; Agnew Hospital, San Diego; Lecturer, University of California, Los Angeles Department.
San Francisco	**PAINTER, George L.**, 135, Stockton Street. *Past Appointment*—Capt. and Assist. Surg. U.S.A. Lune Hospital. *Present Appointments*—St. Mary's Hospital; Adler's Sanatorium.
	RUGGLES, Howard E., 233, Post Street. *Present Appointments*—Roentgenologist to St. Luke's Hospital; University of California Hospital.
COLORADO Colorado Springs	**BROWN, L. Gordon**, 707, No. Cascade Ave.—Exclusive Roentgenological practice, degree of M.D. *Present Appointments*—Roentgenologist to St. Francis Hospital; Bethel Hospital; Glockner Sanatorium, Colorado Springs, Colorado.

COLORADO **Colorado Springs**	**COLE, Joseph G.** Study with Lewis G. Cole, M.O., of New York City. *Present Appointment*—Gerald B. Webb, M.O., Colorado Springs, Colorado.
Denver	**PATTERSON, Lawrence L.**, 301, Majestic Bldg.—M.D. *Present Appointment*—Roentgenologist to St. Anthony's Hospital, Denver.
DISTRICT OF COLUMBIA **Washington**	**MERRILL, Walter Hibbard**, Garfield Memorial Hospital. Degrees, Dartmouth College B.L., George Washington M.D. *Past Appointments*—Emergency Hospital; Instructor, Georgetown University Medical School. *Present Appointments*—Radiologist, Garfield Memorial Hospital; Lecturer, George Washington University Medical School; Radiologist, University Hospital. Author of *The X Rays in the Treatment of Carcinoma*, "Philadelphia Medical Journal," Dec. 8, 1900; *Orthodiagraphy in Study of Heart*, "American Journal Medical Science," Oct., 1909, and Oct., 1910, etc.
	THOMPSON, Harold B., 304, Cobb Bldg., Seattle.—B.S., M.D. *Past Appointments*—King Co. Hospital; City Hospital. *Present Appointments*—Seattle General Hospital; Children's Orthopædic Hospital.
FLORIDA **Jacksonville**	**CUNNINGHAM, Lester Wallace**, 418, St. James' Bldg.—M.D. *Past Appointments*—Resident Physician, Samaritan Hospital, Phila, Pa.; Philadelphia General Hospital, Phila., Pa.; De Soto Sanitorium, Jacksonville, Fla. *Present Appointments*—Roentgenologist, St. Luke's Hospital, Jacksonville, Fla.; Member, American Medical Association; American Roentgen Ray Society.
Tampa	**MACRAE, Jno. D.**, 218-221, American National Bank Bldg.—M.D. and Radiologist. *Present Appointment*—Radiologist to Tampa City Hospital.
ILLINOIS **Chicago**	**TROSTLER, Isador S.**, 615, Garfield Ave. Nineteen years of experience and P. G. work at various times. *Present Appointments*—Roentgenologist, St. Joseph's Hospital, American Hospital, and of the Olivet Institute Dispensary; Professor of Roentgenology, Graduate School of Medicine, Chicago.
Morris	**FERGUSON, Harry M.** *Present Appointment*—Morris Hospital and private work.
IOWA **Iowa City**	**ALLEN, Bundy**, M.D. Private Practice. *Present Appointments*—Roentgenologist to University Hospital; State University of Iowa.
KENTUCKY **Louisville**	**POPE, Curran**, 115, West Chestnut Street. Fifteen years experience. *Past Appointments*—Professor, Physiotherapeutics, Kentucky School of Medicine, and University of Louisville, Kentucky. *Present Appointments*—Medical Superintendent, "The Pope Sanatorium." Author of *Practical Hydrotherapy*; many contributions to contemporaneous literature.

LOUISIANA
New Orleans

SAMUEL, Ernest Charles, Touro Infirmary.—M.D., Tulane University, N.O., La., 1911. *Present Appointments*—Demonstrator of Roentgenology, Tulane University; Roentgenologist, Touro Infirmary; Roentgenologist, Senses Hospital; Roentgenologist, I.C. Railroad Hospital; Roentgenologist, Woman's Dispensary; Consulting Roentgenologist, Charity Hospital. Author of *The Roentgen Ray in Medico-Legal Work; The Roentgen Ray in the Treatment of Fibroid of the Uterus; The Roentgen Ray in the Treatment of Hæmorrhage from the Uterus*, etc.

Shreveport

BARROW, Sidney C. Hutchinson Bldg. Ten years active hospital and private work. *Past Appointment*—Radiologist, Schumpert Sanitarium. *Present Appointments*—Radiologist and Electrotherapist, Shreveport Charity Hospital; North La. Sanitarium; La. Ry. and Nav. Co., K.C.S. Ry. Co.

MARYLAND
Baltimore

WATERS, Charles A., 1100, North Charles Street.—M.D., Member American Roentgen Ray Society. *Past Appointment*—Assistant Roentgenologist, The Johns Hopkins Hospital, Baltimore. *Present Appointment*—Instructor in Actinography, The Johns Hopkins University, Baltimore. Author of *A Modification of the Occipito-Frontal Position in Roentgenography of the Accessory Nasal Sinuses*, "Archives of Radiology and Electrotherapy," June, 1915; *Roentgenology of the Accessory Nasal Sinuses, describing a Modification of the Occipito-Frontal Position*, "American Journal of Roentgenology," February, 1915; *A Report of three cases of Fibrosclerosis of the Penis, treated by Roentgenization, without improvement*, "Surgery, Gynecology and Obstetrics," January, 1915; *Roentgenization of the Thymus Gland in Graves' Disease*, "The Journal of American Medical Association," April 24, 1915.

MASSACHUSETTS
Boston

GRANGER, Frank Butler, 591, Beacon Street.—A.B.. M.D., Instructor in Electrotherapeutics, Harvard Medical School. *Past Appointments*—Consulting Radiologist and Electrotherapeutist, Boston Dispensary; Instructor in Electrotherapeutics, Tufton College Medical School. *Present Appointments*—Physician in charge, Department of Physical Therapeutics, Boston City Hospital; Instructor, Harvard Graduate School of Medicine. Author of *Treatment of Neuritis; Ionic Medication; Elements of Electrotherapy*, etc.

HOLMES, Geo. W., Massachusetts General Hospital.—M.D. *Past Appointments*—Roentgenologist, Children's Hospital; Resident Physician, Long Island Hospital. *Present Appointments*—Roentgenologist, Long Island Hospital; Assistant Roentgenologist, Massachusetts General Hospital. Author of *The Roentgenoscopic Examination of the Stomach and Duodenum; Some Observations upon the Respiratory Movements of the Heart and Diaphragm; Some Experiments in Standardization of Dosage for Roentgen Therapeutics.*

MASSACHUSETTS **Boston**	**O'BRIEN, Frederick W.,** 536, Commonwealth Ave.—Member American Roentgen Ray Society. *Present Appointments*—Roentgenologist to the Brockton and Goddad Hospitals ; Roentgenoscopist to the Boston Dispensary. Author of *Roentgenoscopy or Serial Roentgenograms ; A non-Fatal Fracture of the Axis ; The Present Status of Gall Stone Diagnosis by the Roentgen Ray*, etc.
MICHIGAN **Battle Creek**	**CASE, James T.** Fridays, St. Luke's Hospital, Chicago. M.D., Fellow American College of Surgeons. *Past Appointment*—House Surgeon, Battle Creek Sanitarium for three years. *Present Appointments*—Assistant Surgeon, Battle Creek Sanitarium ; Roentgenologist, Battle Creek Sanitarium ; Roentgenologist, St. Luke's Hospital ; Professor of Roentgenology, North-Western University Medical School, Chicago. Author of *The X-Ray Examination of the Alimentary Tract ;* four volumes (XXXIII—XXXVI inclusive) of the "Stereo Clinic" ; also various pamphlets.
Detroit	**CHENE, George Chas.**—M.D., Exclusive Practice of Roentgenology, Member American Roentgen Ray Society. *Present Appointments*—Roentgenologist, St. Mary's Hospital, Detroit, Providence Hospital, Detroit, Hotel Bien Hospital, Windsor, Ontario, Canada ; Assistant Clinical Professor of Roentgenology, Detroit College of Medicine and Surgery.
	STEVENS, Rollin Howard, 1429-37, David Whitney Building, —Special Courses, Finsen's Med. Ley's Institute, Copenhagen, 1902, Levy-Dorn, Berlin, 1902, fourteen years specializing, Member American Roentgen Ray Society. *Present Appointments*—Assistant Clinical Professor Roentgenology, Detroit Medical College ; Dermatologist and Roentgenologist, Grace Hospital, Detroit.
MISSOURI **Kansas City**	**SKINNER, Edward Holman,** 1019, Rialto Bldg.—M.D., St. Louis University, 1904. *Past Appointment*—Dept. Radiology, University Med. College of K.C., 1910-1912. *Present Appointments*—General Hospital, St. Luke's Hospital ; 1st Lieut., M.R.C., U.S.A. Author of various papers in "A. J. Roentgenology," "Surg. Gyn. and Ob.," "M.O. State Jour.," "Interstate Med. Jour."
St. Louis	**BOTHE, Joseph B.,** City Hospital. Seven years in Roentgenology. *Past Appointments*—Cook Cy. Hospital, Chicago, Ill. ; Washington University Hospital, St. Louis. *Present Appointment*—City Roentgenologist, St. Louis, Missouri.
	ERNST, Edwin C., 401, Humbolt Building.—Roentgenologist. *Past Appointments*—St. Louis City Hospital (Interne) ; Mullanphy Hospital, Resident Physician. *Present Appointments*—Roentgenologist to St. Luke's Hospital (St. Louis) ; Mullanphy Hospital.

MISSOURI
St. Louis

PITTERINGTON, Miles B.—Graduate in Medicine. *Past Appointment*—Radiographer, St. Luke's Hospital. *Present Appointments*—Radiographer, St. John's Hospital; Radiographer, Jewish Hospital; Radiographer, Baptist Hospital; Instructor in Radiography, St. Louis University.

MONTANA
Dillon

WALKER, Maurice A. Four years experience, post-graduate work in New York.

NEBRASKA
Fort Robinson

WEIR, Samuel A., Post Hospital, Radiologist. *Past Appointment*—Army Medical School, Washington.

Omaha

OVERGAARD, Anders P., 770, Brandei's Theatre Building. X-ray work since 1903 at Fremont, Nebraska; recently moved to Omaha. Read several papers before state and local medical societies.

TYLER, Albert Franklin.—B.Sc., M.D., Member American Medical Association, American Roentgen Ray Society, etc. *Past Appointments*—Professor of Roentgenology, Creighton Medical College, and Roentgenologist to St. Joseph's Hospital, Clarkson Hospital, Immanuel Hospital, Douglas County Hospital. Author of *Periostitis Detected by X-Ray*, "Western Medical Review," October, 1912; *Positive Diagnosis of Abdominal Disease by the Roentgen Ray*, "Western Medical Review," July, 1913; *Cysts of Bone*, "Medical Herald," April, 1914; *Urinary Calculi: Value of the X-Ray in their Diagnosis*, "Urologic and Cutaneous Review," July, 1914; *Backache: Some Unrecognized Causes*, "Medical Herald," July, 1914; *The Fulguration Treatment of Certain New Growths*, "Urologic and Cutaneous Review." December, 1914; *Colles Fractures—Important Features*, "Western Medical Review," February, 1915; *Comparison of Roentgenological and Surgical Findings in Certain Abdominal Conditions*, "Western Medical Review," August, 1915; *Colloid Cyst of the Appendix*, "Interstate Medical Journal," September, 1915; *Bone Pathology as Revealed by the Roentgen Ray, with Suggestions as to Treatment*, "St. Paul Medical Journal," October, 1915; *Dislocations of First Cervical Vertebra*, "Western Medical Review," December, 1915; *Desiccation Treatment for Carcinoma*, "Western Medical Review."

NEW JERSEY
Hoboken

BROESER, Henry Valentine, 628, Hudson Street. Trained under Drs. Cole, Holding, Stewart, Law, and Case; X-Ray and Electrotherapeutics for four years. *Present Appointments*—Roentgenologist, North Hudson Hospital, Weehawken, New Jersey; Clinical Assistant, X-Ray Department, Post Graduate Hospital, New York.

NEW YORK
Brooklyn

WASCH, Milton G., 960, St. John's Place. *Past Appointment*—Assoc. Radiologist, Beth Israel Hospital, New York City. *Present Appointment*—Attending Radiologist, Jewish Hospital, Brooklyn, New York.

NEW YORK
Brooklyn

WILLIAMS, John G., 1136, Dean Street. *Past Appointment*—Roentgenologist to St. Catherine's Hospital. *Present Appointments*—Roentgenologist to Brooklyn Hospital, St. Mary's Hospital, Hospital of Holy Family, Swedish Hospital.

Buffalo

GARRATT, John M., 52, North Pearl Street. Seventeen years experience. *Present Appointment*—Consulting Roentgenologist to the J. N. Adam Memorial Hospital. Author of *Roentgenographic Examination of the Urinary Bladder*, "Journal of the American Med. Assn.," Jan. 28, 1911; *Diverticula of the Urinary Bladder, with Special Reference to Roentgen Ray Diagnosis*, "Surg., Gyn. and Obstetrics," Sept., 1911.

REU, Leonard, 1104, Main Street. *Past Appointment*—Treasurer of the American Roentgen Ray Society for three years. *Present Appointment*—Private X-Ray Laboratory.

Glens Falls

BIRDSALL, Edgar. Twelve years experience, Member American Roentgen Ray Society and American Electrotherapeutic Society. *Present Appointment*—Roentgenologist, Glens Falls Hospital.

New York

DARLING, Byron Clary, 122, East 34th Street.—A.B. Illinois College, M.D. Harvard, 1903. *Present Appointments*—Radiologist, Hospital for Ruptured and Crippled, St. Vincent's Hospital, St. Mark's Hospital. Author of *Oral Osteitis in its Relation to Arthritis*, "Medical Record," March 13, 1915.

DE KRAFT, Frederic, 148, West 70th Street.—Graduate Jefferson Medical College, 1883. *Past Appointments*—Chief of Nervous Department of German Poliklinik; Chief of Electrotherapeutic Department, Throat and Lung Hospital. *Present Appointment*—Consulting Physician in Electrotherapy at Manhattan State Hospital. Author of *Effects of Electricity in the Treatment of Gout, ditto in Diabetes, ditto in Headache, High Frequency Currents and X-Ray in Tuberculosis*; articles on the Static Brush Discharge, particularly the blue and blue pencil flame; also many articles on High Frequency Currents; also an article on Neuritis, published in the "International Clinic," etc.

EVANS, Archibald P., 571, Park Ave. *Past Appointments*—Roentgenologist to New York City Children's Schools and Hospitals; Electrotherapist to the New York Neurological Institute; Instructor in the Department of Roentgenology and Electrotherapy of New York Post Graduate School and Hospital. *Present Appointments*—Roentgenologist to the New York Neurological Institute; Roentgenologist to the City Hospital; Attending Physician to the Vanderbilt Clinic Department of Neurology, Columbia College of Physicians and Surgeons, Columbia University; Instructor, Electro-Diagnosis.

FRIEDMANN, Joseph, 133, West 72nd Street, "The Cluny."—Roentgenologist and Roentgentherapist. *Past Appointments*—Instructor in X-Ray and Electrotherapy, New York Post

NEW YORK
New York

Graduate Medical School and Hospital; Roentgenologist to Sydenham Hospital. *Present Appointment*—Roentgenologist to the People's Hospital. Author of *Treatment of Cutaneous Epitheliomata by means of Roentgen Rays*, "Post Grad. Journal," 1910; *Technique of Roentgenography*, "New York Medical Journal," Aug. 24, 1912; *Roentgen Diagnosis*, "New York Medical Journal," Feb. 28, 1914.

LE WALD, Leon Theodore, St. Luke's Hospital, 421, West 113th Street.—Roentgenology. *Past Appointments*—Captain, Medical Corps, U.S. Army; Instructor in Gross Pathology, University and Bellevue Hospital Medical College. *Present Appointments*—Director, Roentgen Department, St. Luke's Hospital, New York; Director, E. N. Gibbs' Memorial X-Ray Laboratory, New York University. Author of *Syphilis of the Stomach*; *Water-Trap Stomach, Report of 100 cases*; *Roentgen Diagnosis of Pyloric Stenosis in Infancy.*

QUIMBY, A Judson, 40, East 41st Street.—M.O. *Past Appointments*—Instructor, Post Grad. Med. School; Professor Radiology, Polyclinic Hospital and Med. School; Radiologist, New York Foundling Hospital. *Present Appointments*—Radiologist, New York Foundling and St. Mary's Hospital. Author of *Comparative Value of Physical Signs and the X-Ray in determining Chest Conditions*; *Chronic Intestinal Stasis*; *Abnormal Angulations of Colon*; *Differential Diagnosis of Appendix by Aid of Roentgen Ray*; *Eleven Cases, Roentgenographic and Operative Findings*; *Intestinal Position and Body Function*; *Unresolved Pneumonia, treated with the X-Ray.*

QUIMBY, Will Amick, 40, East 41st Street.

RUSSELL, Worthington Seaton, 302, East 35th Street.—Radiotherapy. *Present Appointments*—Research Fellow and Chief of X-Ray Department, New York Skin and Cancer Hospital; Prof. of Materia Medica, Ther. and Path., and Director of X-Ray, Lab., Coll. of Dental and Oral Surgery of New York; Pathologist, Tarrytown Hospital; Member Med. Reserve Corps, U.S. Navy, etc. Author of *Radium in Cancer*, "Scientific American"; *Diathermy* (Nagelschmidt) *and Electro-coagulation* (Doyen), "Jour. of Adv. Ther."; articles on Diathermy, Electro-coagulation, and Desiccation in "Reference Handbook of the Med. Sciences"; further Notes on Fulguration in Cancer and Allied Conditions, "Jour. of Adv. Ther," etc.

STERN, Samuel, 41, West 51st Street. Specialising in Radiotherapy for the past fifteen years. *Present Appointments*—Radiotherapist to Mt. Sinai Hospital; Chief of Radiotherapy Department of Mt. Sinai Hospital Dispensary. Collaborator with Dr. Chas. W. Allen in book on Radiotherapy, etc., published in 1904. Author of several papers.

NEW YORK **New York**	**TITUS, Edward C.**, 127, West 11th Street.—M.D *Past Appointments*—Attending Northern Dispensary, New York; Lecturer, Diseases of Children, New York Post Graduate Med. School. Author of (1) *Relative Action of the Roentgen Ray and Light upon the Enzymes, and their Therapeutic Significance*; (2) *X-Ray Treatment of Tuberculosis Adenitis*; (3) *Modern Physical Treatment of Arterial Hypertension*; (4) *Efficiency of Static-wave Current in Treatment of Dysmenorrhœa*; (5) *Present Status of Fulguration therapy*; (6) *Modern Physical Treatment of Gonorrhœal Arthritis by the Static Electrical Currents*; (7) *Some Applications of Light in the Treatment of Disease.*
Rochester	**PALMER, Myson Botsford**, 53, S. Fitzhugh Street.—Roentgenologist. *Present Appointments*—Roentgenologist (Chief) of the Rochester General Hospital and Iola Sanatorium.
Saratoga Springs	**KING, Earl H.**, 75, Caroline Street.—M.D. eighteen years, Radiologist ten years, Member Co. State and A.M.A. *Present Appointments*—Roentgenologist, Saratoga Hospital; Roentgenologist, Saratoga Cure; Roentgenologist, Strong Sanitariam. Author of several articles on medical and surgical subjects, and recently on Roentgenology.
OHIO **Akron**	**WRIGHT, Samuel St. John**, 306, Hamilton Building. *Present Appointment*—Radiologist to the Children's Hospital, Akron, Ohio.
South Canton	**SHORB, John E.**, 423, Market Ave.—M.D. *Present Appointments*—Roentgenologist to Aultman, Ingleside, and Mercy Hospitals.
Toledo	**DACHTLER, H. W.**, 224-226, Michigan Street.—M.D., Roentgenologist; Charter Member, American Roentgen Ray Society; Member, Lucas County Academy of Medicine. *Past Appointment*—Lucas County Hospital. *Present Appointments*—Member of Staff, St. Vincent's Hospital; Flower Hospital; Toledo Hospital. Author of several papers.
PENNSYLVANIA **Clearfield**	**REILEY, William Edgar**, 207, East Cherry Street.—M.D. *Present Appointment*—Roentgenologist to Clearfield Hospital.
McKeesport	**BACHMAN, Milton H.**, 202, Masonic Temple.—M.D. Graduated 1906, Jefferson Medical College, University of Vienna. *Present Appointments*—1910 to 1916 Roentgenologist and Dermatologist to McKeesport, Pennsylvania, Hospital.
Philadelphia	**BOWEN, David R.** 122, So. St. Bernard Street.—M.D. (Jefferson, 1894). *Present Appointments*—Roentgenologist, Pennsylvania Hospital; Assistant Roentgenologist, Jefferson Hospital. Author of *Medical Ethics as related to Roentgenology*, "Pennsylvania State Medical Journal," Oct., 1913; A *System of Development for Roentgen Laboratories*, "Archives

PENSYLVANIA

of the Roentgen Ray," Jan., 1914; *Roentgen Examination of the Sphenoidal Sinus*, "American Journal of Roentgenology," Oct., 1914; *Epiphyseal Separation-Fracture*, "Interstate Medical Journal," XXII-6, 1915.

Pittsburgh

JOHNSTON, George Coffin, Jenkin's Arcade.—Radiologist. *Past Appointment*—Ex-Pres., American X-Ray Society. *Present Appointments*—Prof. Radiology, University of Pittsburgh; Radiologist to Alligheny, Gen. Magee Memorial, Children's, Presbyterian, and St. John's General Hospitals.

TENNESSEE
Memphis

LAWRENCE, Walter S., Bank of Commerce Bldg. Ten years of practice—Roentgenology only. *Present Appointments*—Instructor in Roentgenology in the University of Tennessee; Roentgenologist to City Hospital, St. Joseph's Hospital, and Baptist Memorial Hospital. Author of *A Study of Elbow Joint Injuries in Childhood*, "Surgery, Gynecology, and Obstetrics," Jan., 1912; *A New Position in Radiographing the Shoulder Joint*, "The American Journal of Roentgenology," April, 1915, etc., etc.

TEXAS
Dallas

MARTIN, James Madison, 311-14, Wilson Bldg.—Medical degree, 1892. *Present Appointments*—Roentgenologist to Baptist Memorial Sanitorium, and Private Laboratory at 311-14, Wilson Bldg. Author of *Practical Electrotherapeutics and X-Ray Therapeutics*, published 1912; Editor-in-Chief, "Dallas Co. Medical Bulletin," etc.

UTAH
Salt Lake City

STEWART, Charles W., Suite 504, Walker Bank Bldg.—B.S. (Univ., Chicago, 1896), M.D. (Univ., Denver, 1900). *Present Appointments*—Roentgenologist, Holy Cross Hospital; Salt Lake County Hospital; Roentgenologist for Stewart X-Ray Laboratory, 504, Walker Bank Building, Salt Lake City.

CANADA.

EDMONTON

MALCOLMSON, Geo. H., 9925, 107th Street.—M.B. Toronto University. *Present Appointments*—Royal Alexandra Hospital; Strathcona Hospital.

MONTREAL

MORGAN, James Douglas, 127, Cedar Avenue.—B.A. (Cantab.)—M.D.C.M. (McGill). Private Practice. *Present Appointment*—Radiographer, No. 2 Canadian General Hospital, B.E.F., France.

WILSON, Robert, 596, Wellington Street; at present, Office of Director Medical Services, Canadians, London.—M.D., C.M., Major, Canadian Army Medical Corps; M.D., C.M. (McGill); Member American Roentgen Society; X-Ray Society, London; Fellow American Electrotherapeutic Association. *Past Appointments*—Professor Materia Medica

MONTREAL	and Therapeutics, University, Bishop's College; in charge Department of Radiography and Electrotherapeutics, the Western Hospital, Montreal. *Present Appointments*—Deputy Assist. Director Medical Service, Canadians, London; Officer in charge X-Ray Depts., Canadian Contingent; Surgeon to Grand Trunk Railway, District of Montreal; Secretary to Medical Board, etc.; Radiographer to the Western Hospital, Montreal; also Major and Officer in charge X-Ray Departments, Canadian Army Medical Corps, Canadian Expeditionary Forces. Author of several articles on *Electrotherapeutics; High Frequency Currents; Cinematic Radiography of the Heart,* etc., in Medical Journals.

AUSTRALIA.

NEW SOUTH WALES Sydney	**EDWARDS, James George,** 235, Macquarie Street.—M.B. et Ch.M. (Sydney). *Past Appointment*—Resident Radiographer, Sydney Hospital, 1908-1909. *Present Appointments*—Hon. Radiographer, St. Vincent's Hospital; Hon. Assistant Radiographer, Sydney Hospital.
Sydney	**HARRIS, Herschel,** 215, Macquarie Street.—M.B., M.Ch. Sydney University. *Past Appointments*—Hon. Radiographer, Sydney Hospital; Hon. Assistant Surgeon, Sydney Hospital; President of the Section of Dermatology, Radiology, and Radiumtherapy, Australian Medical Congress, held at New Zealand. *Present Appointments*—Hon. Consulting Radiographer, Sydney Hospital; Hon. Radiographer, Royal Prince Alfred Hospital, Royal Hospital for Children, Royal North Shore Hospital, Western Suburbs Hospital, Tuberculosis Dispensaries, etc., etc. Author of *Hydatid Disease of the Lungs*; *Radiography of the Urinary Tract*; *Experiences of 30,000 Cases of Radiography*; *X Rays in Lymphadenoma*; *Visceral Disease and X Rays*, etc., etc.
VICTORIA Melbourne	**ARGYLE, Stanley,** Alfred Hospital.—M.B., B.Ch., M.R.C.S., L.R.C.P. *Present Appointments*—Skiagraphist, etc., Alfred Hospital; X-Ray Specialist, Australian Imperial Force, No. 2 A.G.H., Ghezeireh, Cairo, Egypt.
	BECKETT, Thomas George, 132, Nicholson Street, Fitzroy.—L.R.C.P. and S., L.S.A. (Lond.). *Past Appointment*—Hon. Medical Electrician and Skiagraphist, Alfred Hospital, Melbourne. *Present Appointment*—Referee, Government State Insurance.
	CLENDINNEN, L. Jack, 105, Collins Street.—M.B., B.S. (Melb.). *Present Appointments.*—Radiologist, Melbourne Hospital; Radiologist, Victorian Eye and Ear Hospital; Radiologist, No. 11, Australian General Hospital.

VICTORIA
Melbourne

HEWLETT, Herbert Maunsell, Melbourne Mansions, Collins Street.—M.B., B.S. (Melb.), M.R.C.P. (Edin.), L.R.C.S. (Edin.). *Past Appointments*—Hon. Med. Officer, Children's Hospital, Melbourne; Lecturer in Physiology to Dental Students, Melbourne University. *Present Appointments*—Hon. Radiographer, Children's Hospital, Melbourne; Hon. Radiographer, St. Vincent's Hospital, Melbourne. Author of several articles on general subjects, but none in special branch.

LEMON, Ferguson, 90, Collins Street.—M.B., B.S. Melbourne University. Author of *X Rays and their Uses*, 1910, Monograph; *X Rays in Joint Injuries*, "A. M. J.," August, 1912; *Localisation of Bullet in Brain*, "Archives of the Roentgen Ray" 1911; *Uses of Phosphorus in Diseases of Lung*, 1913; *X Rays in War*, "Archives of the Roentgen Ray," 1914.

Nhill

RYAN, Thomas Francis, Nelson Street.—M.B., Ch.B. (Melb.). *Present Appointment*—Nhill Hospital, Victoria. Author of papers on *Iodoform Knockenplombe (Iodoform bone filling); Skiagraphy dealing with the Gradual and Eventual Disappearance of the filling from the Bone and Replacement by Osseous Tissue*, Australian Medical Congress, 1911, and Australian Medical Congress, 1914.

NEW ZEALAND.

AUCKLAND

McDOUGALL, Neil, 27, Khyber Pass Road.—A.M., M.B., Ch.B. *Present Appointment*—Honorary Radiologist, Auckland Hospital, Auckland.

DUNEDIN

CAMERON, Percival Douglas, 311, Leith Street.—M.D. (Edin.). *Past Appointments*—Voluntary Assistant in Medicine, Johns Hopkins Hospital, Baltimore; Clinical Assistant and Resident Physician, Royal Infirmary, Edinburgh; Assistant Pathologist, Dunedin Hospital. *Present Appointment*—Radiologist and Medical Electrician, Dunedin Hospital. Author of *Physiological and Pharmacological Studies on Cardiac Tonicity in Mammals*, "The Johns Hopkins Hospital Reports," Vol. XVI, 1911.

WELLINGTON

CAMERON, Robert Allan, 123, Willis Street.—M.B., Ch.B. (Edin.), L.M. (Dublin). *Past Appointment*—House Surgeon and Radiologist, Cancer Hospital, London. Author of *Notes and Radiographs of Cancer of Stomach*, "New Zealand Medical Journal," 1915.

AFRICA.

CAPE TOWN

HUGO, D. de V., Mansion House Chambers.—M.B., C.M., J.P. *Past Appointments*—R.M.O., District Surgeon; Medical Officer of Health. Author of *Modern Electrotherapeutics; The Cancer Problem; Radiology and Electrotherapeutics*, etc.

CAPE TOWN	**REYNOLDS, Howard W.**, 150, St. George's Street, M.B., B.Sc. (Lond.). *Present Appointment*—Physician in charge, X-Ray and Electrical Department, New Somerset Hospital, Cape Town.
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INDIA.

FORT BOMBAY	**DE SA, Victor**, St. George's Hospital.—Bachelor of Medicine and Bachelor of Surgery. *Present Appointments* — Civil Assistant Surgeon, St. George's Hospital, Fort Bombay, and Radiologist and Electrotherapist to St. George's Hospital.
MUSSOORIE	**WALTER, Major A. E.**, Rectory Lodge, Mussoorie.—M.R.C.S., L.R.C.P., I.M.S. *Present Appointments.*—Superintendent, X-Ray Institute of India ; Officer Commanding Lady Chelmsford Special Red Cross War Hospital. Author of *X Rays in General Practice*, 1906 ; *A Practical Guide to X Rays, Electrotherapeutics and Radiumtherapy for Students and Practitioners.*

CHINA.

SHANGHAI	**MACLEOD, Neil**, 406, Avenue Joffre. M.D., C.M. (Edin.). *Past Appointments*—Surgeon, Shanghai General Hospital ; Surgeon, H.B.M. Consulate-General. *Present Appointment*—Radiologist, Shanghai General Hospital.

SOUTH AMERICA.

ARGENTINA **Buenos Aires**	**HEUSER, Charles**, Cucuman 974.—Med. Dr., Gefe del Servicu de Electroterapa del Hospital W. de Micuados. En la Semana Medica desde 1902, hasta la fecha todos los Años en la Argentina medica hay varios articulos desde, 1910.

BRAZIL **Rio de Janeiro**	**TOLEDO DODSWORTH, Jorge de**, Avenida Rio Branco, 108.—Assistant at the Faculty of Medicine of Rio de Janeiro, Member of the "Société de Radiologie de France," Director of the "Brazilian Review of Physiotherapy." Author of *Rontgen-diagnostico do estomago no adulto*; *Etude radiographique a'un cas de "Myosite ossifiante progressive."* With Prof. Dr. Toledo Dodsworth, *Contribution radiographique sur une nouvelle Trypanosomiase humaine*, Congrès de Lyon (1914); *Radiographies cliniques*, Congrès de Lyon (1914).
CUBA **Havana**	**RIVERO, Filiberto**, Reina 127.—M.D., Physician. *Past Appointment*—Director of the State Sanatorium. *Present Appointment*—Director of "Instituto de Radiologia y Electricidad Medica."
Havana	**DOMINGUEZ ROLDAN, Alfredo G.**, 107, San Miguel Street.—*Past Appointment*—Head X Rays Service, Tamayo Dispensary, Havana, Cuba. *Present Appointment*—X Rays Institute, 107, San Miguel Street, Havana, Cuba. Author of *Contributions to the Treatment of Uterus Fibroma by X Rays.*

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